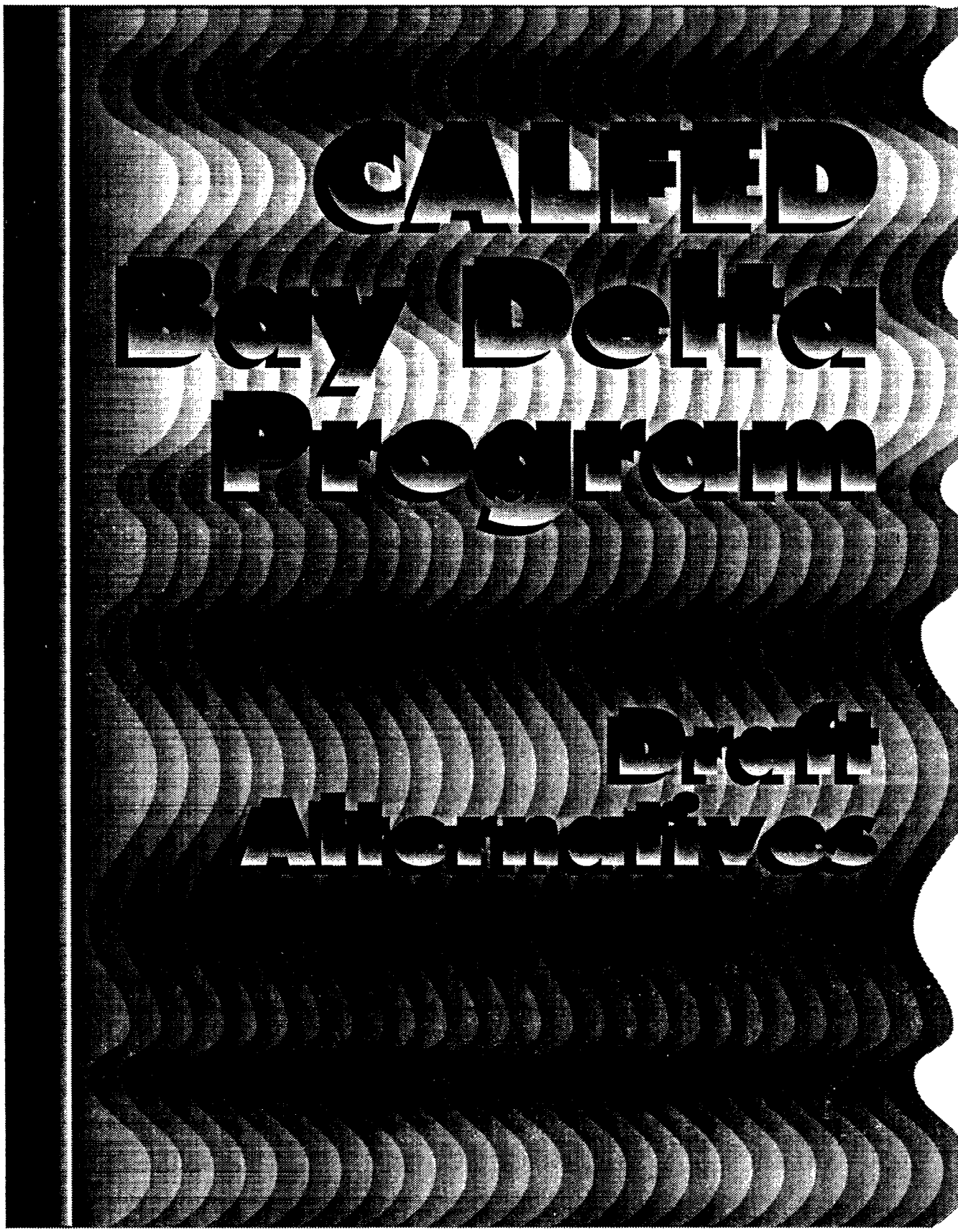


B-004608

CALFED Bay-Delta Program
Draft Alternatives

Number	Description
EX-1	Large Isolated Transfer Facility
EX-2	Small Isolated Transfer Facility
EX-3	Reduce Demand
EX-3.1	Soft Path Approach
EX-4	Chain of Lakes
WS-12	Improved Through-Delta Conveyance with Screened Diversion at Hood
WS-13	Dual Transfer Facility
WS-14	West-side Sacramento Storage and Conveyance Facility
WS-15	Eastside M&I Conveyance Facility
WS-16	Water Transfers with Existing Pumping Capacities
WS-17	Develop Transfer Supplies with Additional South of Delta Storage
EQ-1	Reduce Diversion Effects and Small Transfer Facility
EQ-2	Maximum Habitat Restoration
EQ-3	Moderate Habitat Restoration
EQ-4	Baseline Level Habitat Restoration
EQ-5	Sacramento Ship Channel
SV-1	Minimum Protection Level of Delta Islands and System Functions
SV-2	Moderate Protection Level of Delta Islands and System Functions
SV-3	Maximum Protection Level of Delta Islands and System Functions
WQ-1	Pollutant Source Controls and Salinity Management
WQ-2	Improve Delta Flow Through Operational Modifications
WQ-3	Pollutant Source Control and in-Delta flow Management Using Added Upstream Storage
WQ-4	Chain-of-Lakes Isolated Facility
WQ-5	East-side Delta Isolated Facility

Supply

Alternative EX-1

Group
Water Supply

Title
Large Isolated Transfer Facility

This alternative emphasizes reducing entrainment of fish and fish food by relocating both M&I and agricultural export diversions to the Sacramento River near the northerly edge of the Delta. By reducing the flow of water through the Delta to the existing export pumps, residence time is increased, resulting in substantial improvements in aquatic habitat productivity in the Delta. The new diversion location also results in substantial improvements in export water quality, and reduces the need for "carriage water" releases, making additional water available for environmental uses and/or water supply. This alternative decreases the pollutant load entering the Delta from the San Joaquin River through implementation of source control measures, offsetting the decrease of Sacramento River inflow to the Delta resulting from the diversion relocation. Vulnerability of Delta functions to catastrophic failure is reduced by levee improvements associated with habitat improvement measures in the Delta.

Major physical features include a new conveyance facility to transport water from the new diversion point, around the Delta to the existing export conveyance facilities. The capacity of the new facility matches the capacity of the existing export conveyance facilities. Water supply conditions in the Delta are improved by construction of flow control structures in the South Delta which provide adequate water levels to support continued in-Delta diversions. Vulnerability of Delta functions to catastrophic failure is reduced by levee improvements associated with habitat improvements and at islands throughout the Delta.

Key Actions

Install Barriers—Install barriers to maintain adequate water levels for in-Delta diversions .

Construct Large Isolated Transfer Facility—Construct a new conveyance facility to transport water from the new diversion point around the Delta to the existing export conveyance facilities. The capacity of this facility matches the physical capacity of the existing CVP and SWP export facilities.

Habitat Restoration—Restore riverine, riparian, wetland, and adjacent terrestrial habitat, and expand floodway habitat, channels, and meander belts in the Bay-Delta and upstream in rivers and tributaries to restore fish spawning, rearing, and feeding habitats and improve fish survival. islands with relatively high interior surface elevations). The amount of in-Delta habitat restoration included is smaller relative to alternatives which maintain in-Delta M&I and/or agricultural export diversions.

Relocate Diversions—Relocate export diversions to a point or points on the Sacramento River near the northerly edge of the Delta (e.g. Hood). Provide best available technology fish screens. Real-time monitoring is used to avoid entraining large concentrations of striped bass eggs and larvae, otherwise, pumping can occur continuously. The single point of diversion, on the river, reduces the number of fish exposed to the diversion, the length of time fish are exposed to the

diversion, and eliminates the rerouting of fish associated with the circulation associated with current export diversion locations in the south Delta. The new diversion point also provides access to higher quality water for export.

Control Predators—Harvest predators at Delta and upstream diversions, holding areas, and other environmentally sensitive areas in the Sacramento and San Joaquin river basins.

Reclamation—Reclaim agricultural, municipal and industrial wastewater for a variety of uses, improving water quality by reducing wastewater discharges.

Manage Drainage/Discharges—Impose in-Delta and upstream cropping and irrigation practices to increase the effectiveness of chemical applications to reduce nonpoint source leaching volumes and concentrations. Improve drainage timing for dilution during high flow periods to reduce instream impacts. Set pollutant load limits in the San Joaquin and Sacramento Rivers. Prevent toxic discharges from industrial plants using stronger enforcement, especially during environmentally sensitive periods. Implement selective land retirement in the San Joaquin Valley aimed at reducing pollutant loading of the San Joaquin River.

Improve and Protect Riparian Habitats—Restore riparian habitat at greater than core levels to mitigate losses associated with development of the isolated conveyance facility.

Protect, Enhance and Expand Existing Wetlands—Improve and expand existing wetlands to mitigate losses associated with development of the isolated conveyance facility.

Floodway Habitat Improvement—Create new habitat by allowing rivers to meander within existing levees upstream of the Delta.

Levee Upgrades—Provide landside buffer zones of at least 75 yards to minimize levee subsidence and improve levee maintenance and stabilization to at least hazard mitigation plan standards (HMP; a level of protection less than the 100-year flood) for islands providing valuable existing habitat, such as on Bradford Island. Improve levee maintenance and stabilization to at least National Flood Insurance Program standards (NFIP; 100-year flood protection) and to maximum credible earthquake standards (MCE) for all islands, such as Tyler and Mandeville, containing existing infrastructure and/or land use that provides economic benefit to the region. Improve levee maintenance and stabilization to at least Bulletin 192-82 or PL-99 standards (generally considerably more than 100-year flood protection) and to MCE standards for critical western Delta islands, such as Brannan-Andrus, Bethel, and Sherman, to reduce risk to critical infrastructure (e.g. Mokelumne Aqueduct, PG&E gas lines, Highway 160) and to reduce risk to export water quality from salinity intrusion due to levee failure. A levee management plan would provide necessary funding for ongoing maintenance and emergency funding and direction to reclaim Delta islands in the event of inundation in order to continue protection of Delta functions as an integrated resource system.

Preliminary Assessment

Ecosystem Quality—This alternative substantially improves ecosystem quality primarily through reduction of diversion effects on fish. Relocating the export diversions also increases in-Delta residence time, resulting in substantially improved aquatic habitat productivity. Habitat restoration is provided to mitigate for losses resulting from the construction of the isolated facility. Additional in-Delta habitat restoration is included at a relatively low level to supplement the ecosystem quality benefits provided by the diversion relocation.

Water Supply—By relocating and consolidating export diversions, supply reliability is improved by effectively reducing pumping restrictions associated with fish entrainment.

Water Quality—This alternative improves export water quality through relocating export diversions to the Sacramento River, a significantly higher quality source than the South Delta. Water quality within the Delta is improved through reduction of pollutant loading from the San Joaquin River, and through reclamation and management of wastewater.

System Vulnerability—Constructing an isolated conveyance facility essentially eliminates the risk that water supply operations will be interrupted by a failure of in-Delta facilities. Creation of habitat through construction of setback levees and habitat corridors simultaneously provides better levees and protection for adjacent land uses. Core actions improve the reliability of in-Delta facilities through levee management and levee reconstruction.

Alternative EX-2

Group
Water Supply

Title
Small Isolated Transfer Facility

This alternative focuses on decreasing entrainment of anadromous and Bay-Delta native fish and fish food, primarily through relocation of M&I export diversions. The new diversion location, by reducing the conveyance of water through the Delta to export pumps, increases the residence time of water in the Delta, improving aquatic habitat productivity. The relocated diversion also improves the water quality of SWP exports, and reduces constraints on M&I exports associated with entrainment of fish.

A small, isolated transfer facility is included to connect the relocated diversion to Clifton Court Forebay. The Clifton Court Forebay gates would normally be closed. The isolated facility essentially eliminates the vulnerability of M&I export supplies to catastrophic failure. Delta water quality is improved by reducing pollutant loading of the Delta via the San Joaquin River and through agricultural, industrial, and municipal wastewater reclamation and reuse. The vulnerability of Delta land use, Delta water supply, agricultural export water supply and Delta ecosystem function to catastrophic failure is reduced by improving levees throughout the Delta.

Key Actions

Habitat Restoration—Restore riverine, riparian, wetland, and adjacent terrestrial habitat, and expand floodway habitat, channels, and meander belts in the Bay-Delta and upstream in rivers and tributaries to restore fish spawning, rearing, and feeding habitats and improve fish survival. A level of restoration involving setback levees, channel improvements, and shaded riverine habitat is focused on high priority sites (e.g. to form corridors of key habitat mosaics), and sites of high feasibility (e.g. along north Delta islands with relatively high interior surface elevations). The amount of in-Delta habitat restoration is smaller relative to that included in alternatives that maintain both M&I and agricultural export diversions at their current South Delta locations, and higher relative to that included in alternatives that relocate both M&I and agricultural export diversions.

Construct Small Isolated Transfer Facility—Transport water around the Delta from the new M&I diversion location to Clifton Court Forebay in a facility sized to meet export M&I needs (approximately 5,000 cfs; Southern California, Central Coast, and South Bay SWP contractors).

Relocate Export Diversion Facilities to Sacramento River—Provide M&I exporters access to higher quality water while reducing the entrainment effects of existing facilities by relocating export diversion facilities to the Sacramento River upstream of the Delta, near Hood for example. Provide best available technology fish screens. Real time monitoring is used to avoid entrainment of large concentrations of striped bass eggs and larvae, otherwise pumping could occur at any time.

Levee Upgrades—Provide landside buffer zones of at least 75 yards to minimize levee subsidence and improve levee maintenance and stabilization to at least hazard mitigation plan standards (HMP; a level of protection less than the 100-year flood) for islands providing valuable existing habitat, such as on Bradford Island. Improve levee maintenance and stabilization to at least National Flood Insurance Program standards (NFIP; 100-year flood protection) and to maximum credible earthquake standards (MCE) for all islands, such as Tyler and Mandeville, containing existing infrastructure and/or land use that provides economic benefit to the region. Improve levee maintenance and stabilization to at least Bulletin 192-82 or PL-99 standards (generally considerably more than 100-year flood protection) and to MCE standards for critical western Delta islands, such as Brannan-Andrus, Bethel, and Sherman, to reduce risk to critical infrastructure (e.g. Mokelumne Aqueduct, PG&E gas lines, Highway 160) and to reduce risk to export water quality from salinity intrusion due to levee failure. A levee management plan would provide necessary funding for ongoing maintenance and emergency funding and direction to reclaim Delta islands in the event of inundation in order to continue protection of Delta functions as an integrated resource system.

Reclamation—Reclaim agricultural, municipal, and industrial wastewater for a variety of uses, improving water quality by reducing wastewater discharges. Selectively retire land in the San Joaquin Valley to reduce pollutant loading of the Delta from the San Joaquin River.

Preliminary Assessment

Ecosystem Quality—This alternative would substantially improve ecosystem quality through the reduction of diversion effects that occurs with the relocation and screening of M&I export diversions. The diversion relocation also increases residence time in the Delta, improving aquatic habitat productivity.

Water Supply—The relocated M&I export diversion reduces the constraints currently associated with entrainment of fish at the SWP export diversion, thereby improving M&I export water supply and reliability. M&I export diversion relocation also results in decreased "carriage water" requirements, making more water available for water supply and environmental uses.

Water Quality—This alternative improves M&I export water quality by relocating M&I diversions upstream of the Delta. Delta water quality is improved through reduction of pollutant loading from the San Joaquin River along with reclamation of agricultural, municipal, and industrial wastewater.

System Vulnerability—Relocating M&I export facilities outside of the Delta essentially eliminates the risk that operations will be interrupted by a failure of in-Delta facilities. In-Delta habitat restoration simultaneously provides better levees and protection for adjacent land uses. Improvement of the levees around Delta islands protects those islands as well as protecting in-Delta and agricultural export water supplies from salinity intrusion due to island failure.

Possible Variations

Small isolated transfer facility constructed as a closed pipeline with multiple diversion points along the east side of the Delta. Full isolated transfer facility (15-20K cfs), isolated transfer facility for SWP water only (approximately 10K cfs).

Possible Supplemental Actions

Construct a westside canal from Keswick Reservoir to reduce diversions from the upper Sacramento River and the fish passage problems at Red Bluff Diversion Dam. Improve Delta tidal habitats for Delta smelt. Construct in-Delta storage to provide operational flexibility at the CVP pumps and regulate Delta outflow for fish enhancement.

Alternative EX-3

Group
Water Supply

Title
Reduce Demand

The essential theme of this alternative is resolution of both the water supply and ecosystem problems through reductions in Delta exports (while retaining the current intake locations). The theory is that if: (1) the overall volume of exports can be reduced; (2) the within-year timing of exports can shifted away from the February -- June period; and (3) spring outflows increased, then the environment should respond positively. The challenge in this alternative is to provide for these changed diversion patterns without harming water users in the export areas. Water quality elements and levee stability elements are added as necessary to fill out the alternative.

Reductions in Delta export volume and timing can, in general, be accomplished through a combination of three basic approaches: (1) reduced demand (e.g., conservation, land retirement, land fallowing); (2) substitution of non Delta supplies (recycled water, a new Colorado River aqueduct); and (3) south of Delta storage (to allow for greater flexibility in export timing). This particular alternative relies upon choices made from each of these categories (conservation, land buyouts, land fallowing, and recycling). Demand shifts could also be generated in other ways without substantially changing the character of this alternative. Also, of a continued reliance on a south Delta export location, this alternative emphasizes protection of key western Delta islands to protect against disruption of the export system. Finally, urban and agricultural conservation and recycling should improve water quality above and beyond the core action list.

Key Actions

Conservation--- Improve implementation of urban Best Management Practices (BMPs). Tighten BMPs to require inclining block rate pricing (designed to reduce landscape water use). Implement agricultural Efficient Water Management Practices (EWMPs). EWMPs including: measurement of deliveries; pricing and incentives designed to optimize management (efficiency of use, conjunctive use), grower access to markets. Higher rates of conservation allow for retention of the benefits of water user while lowering the demand for water from the Delta. These conservation elements go well beyond the conservation core actions.

Reclamation--- Maximum reclamation and reuse of urban and agricultural supplies. For example, implement the Bay Area--Central Valley recycling/exchange project and a Southern California--Imperial Valley recycling/exchange project. (Alternatively, move to largescale potable reuse). Maximize agricultural drainage reclamation. Substituting recycled water for Delta water lowers the demand for water from the Delta. These reclamations go far beyond the reclamation core actions.

Land Retirement and Fallowing---Maximize retirement of marginal agricultural lands and lands of willing sellers. Emphasize purchase of land which contributes to regional drainage and discharge problems. The retirement of land south of the Delta reduces the demand for water from the Delta. This action goes well beyond the land retirement and fallowing core action.

Water Transfers---Increase the efficient utilization of existing water supplies by facilitating water marketing. In particular, transfer significant amounts of water from the Imperial Valley to Southern California urban areas. Water transfers are not independent of agricultural conservation, land retirement, and land fallowing. Rather, market incentives will lead to agricultural conservation, land retirement and land fallowing. The formal transfer element does not go beyond the water transfers core action. It is likely, however, that water transfers will play a more important role in this alternative than in alternatives which supplies south of the Delta.

Operational Factors--- Environmental standards will be changed to reduce exports and to increase Delta outflow during the February - June period.

Flow Barriers--- Install flow barriers in the South Delta to support existing in-Delta diversions. Because a south Delta pumping location is retained in this alternative, south Delta barriers are needed to protect south Delta agriculture.

Habitat Restoration---Habitat protection is largely determined by the core actions. Additional habitat restoration activities would include:

- Fund the State of California cost share portion of the fish and wildlife restoration activities of CVPIA.
- Provide 100 miles by 50-feet wide shallow river habitat in the Delta.
- Convert 5000 acres of diked wetlands to tidal action between Chips Island and Carquinez Strait.

Levee Upgrades—Provide landside buffer zones of 20 to 50 yards to minimize levee subsidence for islands providing valuable existing habitat, such as on Bradford Island. Improve levee maintenance and stabilization to at least hazard mitigation plan standards (HMP; a level of protection less than the 100-year flood) for all islands, such as Tyler and Mandeville, containing existing infrastructure and/or land use that provides economic benefit to the region. Improve levee maintenance and stabilization to at least National Flood Insurance Program standards (NFIP; 100-year flood protection) for critical western Delta islands, such as Brannan-Andrus, Bethel, and Sherman, to reduce risk to critical infrastructure (e.g. Mokelumne Aqueduct, PG&E gas lines, Highway 160) and to reduce risk to export water quality from salinity intrusion due to levee failure. A levee management plan would provide necessary funding for ongoing maintenance and emergency funding and direction to reclaim Delta islands in the event of inundation in order to continue protection of Delta functions as an integrated resource system.

Possible Modifications/Additions

Develop Export-Area Alternative Supplies---Develop alternative water supplies such as desalination and potable reuse for export areas.

South Delta Facilities---Implement program to allow utilization of full capacity of export

facilities. Would increase system flexibility and capacity, with benefits distributed in some fashion between exporters and the environment (i.e., could be used to further reduce critical period exports, or to increase export supplies or some combination). Not, strictly speaking, part of a no facilities alternative, but high benefit with minimal intrusion.

Surface Storage---Increased storage increases system flexibility and capacity. Could be used for increasing export water supplies and/or improved environmental flow/diversion conditions.

Groundwater Banking and Conjunctive Use--- Same benefits as surface storage. However, without additional facilities, the potential for groundwater use in the export areas is somewhat limited.

Increase Export Throughput Capacity---Increase capacity of export canals with increase in export pumping plant capabilities. Increases system flexibility/capability. Could be used for increasing export water supplies and/or improved environmental flow/diversion conditions.

Habitat Restoration--- No major ecosystem restoration program was included in this alternative because of implementability issues. This alternative deals with the conflict between water supply and the ecosystem by reducing exporter dependance on the Delta (at great expense). Considering that water users could achieve such an outcome on their own already without any concessions to the environment, it is unlikely that they would be willing to foot the bill for a major habitat restoration program if demand management were selected as an alternative. However, if the people of California foot the bill for many of the demand side measures, then an ecosystem restoration program could be justified.

Preliminary Assessment

Ecosystem Quality—This alternative would improve ecosystem quality primarily through moderate reductions in the entrainment caused by the export pumps and through moderate increases in spring outflow. The alternative includes only minor improvements in physical habitat area. The success of this alternative hinges on the degree to which entrainment and spring outflow limit ecosystem quality and the degree to which entrainment can be reduced and outflows increased through the actions suggested.

Water Supply—This alternative improves M&I water supply reliability by reducing reliance on the Delta as a source of water supply through demand reductions. Moreover, by including near total reclamation for both northern and southern California, an automatic feedback mechanism is built in to help compensate for future growth (as demand increases, reclamation increases). However, as the consumptive use (e.g., landscaping) of water within urban areas increases in the future, supply and demand could become unbalanced or (more likely), agricultural acreage would decline in the export areas as a result of an increasing level of water transfer.

Water Quality—Water quality is improved through reclamation of agricultural, municipal, and industrial wastewater and through improvements in the water quality of diversions. Other water quality improvements are achieved by supporting and core actions including mine drainage remediation.

System Vulnerability— Improvement of the levees around the Delta islands reduces risk to those islands as well as reducing risk to in-Delta and export water supplies from salinity intrusion due to island failure. Other core actions enhance the reliability of in-Delta facilities through levee management.

Alternative EX-3.1

Group
Water Supply

Title
Soft Path Approach

"Hard path" approaches can be characterized by an emphasis on the expansion of water diversions, improvements in water quality, or mitigation for past damage using facilities and actions which intrude upon the natural workings of the environment. By contrast, "soft paths" seek to restore natural functions and to reduce human manipulation of those functions. This alternative, while focussing on changing flow and diversion patterns, takes a "soft" approach.

The distinction between hard and soft paths is not always clear in the Bay-Delta system. The system is already heavily managed and the Delta environment and species mix has already been highly distorted over the last century. For purposes of this alternative, "hard" elements are considered to be facilities or actions which further distort "natural" processes. Soft elements are those which reduce human intrusion into the environment. Thus, "hard" elements would include:

- o Conveyance facilities which distort natural flow patterns (e.g., new Delta transfer facilities).
- o Storage facilities which major site specific impacts (e.g., surface storage, especially on-stream storage).
- o Hatcheries.

Soft elements would include measures which seek to:

- o Restore and protect natural flow patterns -- higher spring Delta outflow, fewer reverse flows, etc.
- o Reduce overall diversions from the system -- conservation, reclamation, water transfers, cropping shifts.
- o Reduce the impact of remaining diversions -- screening and real time management.
- o Restore habitat.
- o Reduce other human impacts on the system -- ballast requirements, water quality, etc.

Some actions may be a mixture of hard and soft paths. For example, increases in spring outflow (soft) might be generated through new facilities and reductions in high flows (hard).

This alternative emphasizes the various "soft" elements discussed above. It does include several harder elements, however such as Delta island storage and new conveyance in the south-west San Joaquin Valley. These facilities believed justified because they reduce the effect of past engineering choices on the natural system in ways that are relatively unintrusive.

Key Actions

Demand management— Cap average diversions from the Bay-Delta tributaries and from the Delta at current levels. Require demand management measures adequate to assure that this

level of diversion will meet future needs. Demand management would include the appropriate mixture of the following measures:

Conservation. Improve implementation of urban Best Management Practices (BMPs). Tighten BMPs to require inclining block rate pricing (designed to reduce landscape water use). Implement agricultural Efficient Water Management Practices (EWMPs). EWMPs including: measurement of deliveries; pricing and incentives designed to optimize management (efficiency of use, conjunctive use), grower access to markets.

Reclamation. Includes both urban and agricultural supplies. Urban options include local non potable use, potable reuse, and urban-agricultural water exchange.

Land Retirement. Fund retirement of significant amounts of land south of the Delta. Emphasize lands which contribute to drainage and water quality problems.

Water Transfers. Create a transfer clearinghouse to facilitate the movement of water from willing buyers to willing sellers. Reduce transaction costs by developing criteria for fast track transfers. Buyers willing to abide by the criteria for fast track transfers (timing, source of water, mitigation) would face minimal regulatory requirements for transfer, including transfer from north to south of the Delta.

In-Delta storage facilities— Convert several Delta islands south of the San Joaquin River into facilities capable of storing 2 - 300,000 acre-feet of water (e.g., Bacon Island and Webb Tract). The storage would be controlled by environmental agencies. This element is arguably "soft" in the sense that the islands are probably not sustainable in the long-term in present land uses due to continued subsidence. Nor would failure of the island promote restoration due to their depth (-20 feet). The on-site impact of the islands for storage, therefore, should have no major long-term adverse environmental impacts. On the other hand, use of the island for storage allows for amelioration of current export impacts (see "Operations").

Delta channel capacity improvement— The capacity of channels in the southern Delta would be increased to allow use of the export pumps at their full 15 kcfs capacity. This element is "hard" in appearance. However, the increased export capacity would be used to shift pumping timing away from environmentally damaging period to lower impact periods.

Ground water storage south of the Delta— Groundwater storage in the west and southern San Joaquin Valley will be used more actively for storage purposes. Direct percolation will be used to bank water supplies. Also, in lieu conjunctive use programs (higher deliveries of surface supplies in wet years, lower deliveries in dry years) will be greatly expanded. This expansion may require a restructuring of state and federal contracts and/or new conveyance/ distribution facilities. The new storage would be controlled by environmental agencies.

Delta island screening— Fund existing DFG screening mandates to cover all high priority screening sites.

Barriers— Install an acoustic barrier at Georgiana Slough. Install a barrier at Old River. Install barriers in the South Delta to protect agricultural water quality.

Habitat restoration— Habitat restoration elements above the core elements would include:

Fully fund the restoration mandates of the CVPIA.

Restore a certain acreage (e.g., 20,000 acres) within the Delta to natural habitats, including shallow, riparian, shaded riverine, and wetland.

Operations/ Standards— Changes in current operational patterns/standards will be made in the following areas:

- Real time management. Monitoring and real time operations will be implemented intensively with the goal of reducing diversion impacts on the environment while retaining water supply reliability. As with the Operations Group currently, real time management could include exports at levels above the nominal standards, if coupled to reductions in exports at other times sufficient to provide a net environmental benefit.

- Environmental Storage. Environmental agencies would control the storage in the Delta islands and in new groundwater storage south of the Delta. Decisions on when to fill and when to release would be made at their discretion, subject to overall guidelines. One guideline would mandate that the top priority for use of the storage must be to avoid interruptions in export supplies due to take limits (both prospectively and retrospectively). In general, water could be released for environmental purposes (e.g., to boost outflows), exchanged (e.g., turned over to the export projects in return for lower export rates), sold (to generate additional money for various environmental purposes), or used to guarantee real time operations in which the environment accepts a debt to water users. Examples of likely operations would include:

    - Use of storage to reduce exports below 35% of inflow.
    - Use of storage to reduce exports below 100% of San Joaquin inflow during April and May (or to provide a substitute source of water for the pumps from the islands, thereby reducing the damage caused by export pumps).

- New Standards. A new salinity X2 compliance point in San Pablo Bay structured to assure that an adequate frequency of pulse flows are allowed to flow into San Francisco Bay. The increased south Delta export capacity would be subject to new export standards limiting the time of use to high flow periods.

- Barriers. Give environmental agencies control over the Delta Cross Channel barrier from November -- June. In general, the DCC will remain closed during this period unless environmental agencies are confident that downmigrating salmon smolts are not present or that the barrier should remain open to reduce reverse flows. Operate the Old River barrier during April-May outmigration pulses.

Levee upgrades— Provide landside buffer zones of 20 to 50 yards to minimize levee subsidence for islands providing valuable existing habitat, such as on Bradford Island. Improve levee maintenance and stabilization to at last hazard mitigation plan standards (HMP; a level

of protection less than the 100-year flood) for all islands, such as Tyler and Mandeville, containing existing infrastructure and/or land use that provide economic benefit to the region. Improve levee maintenance and stabilization to a t least National Flood Insurance Program standards (NFIP; 100-year flood protection) for critical western Delta islands, such as Brannan-Andrus, Bethel, and Sherman, to reduce risk to critical infrastructure (e.g., Mokelumne Aqueduct, PG&E gas lines, highway 160) and to reduce risk to export water quality from salinity intrusion due to levee failure. A levee management plan would provide necessary funding for ongoing maintenance and emergency funding and direction to reclaim Delta islands in the event of inundation in order to continue protection of Delta functions as an integrated resource system.

Funding— A significant fraction of the funding for this alternative would probably need to come from state or federal level sources in order to satisfy the equity criterion.

Preliminary Assessment

Ecosystem Quality—This alternative would provide moderate improvements in environmental quality. Average demand would be capped at current levels and seasonal diversion patterns would be shifted toward times of lower impacts. Real time management, the operation of various barriers, a moderate level of habitat restoration, and the water quality core actions would also promote environmental health. However, the level of benefit is probably limited by the continued existence of significant entrainment impacts at the south Delta pumps, limited improvements in spring outflows, and a level of habitat enhancement which is lower than alternatives more focussed on habitat enhancement. It would be possible to develop other "soft path" alternatives which provide more environmental protection by further reducing demand or increasing the amount of habitat restoration -- at a higher cost.

Water Supply—This alternative would improve the reliability of water supplies (at current levels) by improving real time management techniques, requiring new storage to be used first for responding to ESA take problems, by reducing the transaction costs for water transfers, and by increasing the proportion of reclaimed water (a highly reliable source) in the supply mix. Various demand side measures would assure that net demand for Delta water does not rise in the future. Constant demand for Delta should keep supply conditions from deteriorating in the future. However, as a result of "demand hardening", the reliability of supply should increase as efficiency increases if the damage from shortages is to be kept constant. This alternative does not provide for such increases, though the market should allow for some adjustment. In the long term, if urban growth continues, either very expensive reclamation programs would be necessary or large amounts of export agriculture would go out of production.

Water Quality—Water quality for users is the weakest element of this alternative. The core elements, and agricultural land retirement should improve the quality of water entering the Delta. Barriers in the south Delta should improve quality for agriculture there. However, more frequent Delta Cross Channel closures and the use of storage from Delta islands will lower water quality for Delta agriculture and for export. Water quality should remain adequate for Delta farming and export agriculture. However, the cost of treatment of exports drinking water will probably remain at least at currently projected levels, if not above them.

System Vulnerability—This alternative provides significant improvements in levee stability. Significant risks of major levee failures remain, however, posing risks to in-Delta water users, in-Delta habitat and export supplies. The south of Delta storage and in- Delta storage would both tend to reduce the consequences of major levee failure to export areas somewhat.

Alternative EX-4

Group
WATER SUPPLY

Title
Chain of Lakes

This alternative is centered on the construction of a chain of lakes to store water and transport it through the Delta. It is intended to achieve substantially greater protection of anadromous and resident fish from diversion effects, greater aquatic habitat productivity in the Delta, and more reliable and high quality supply of water for export. The water supply would be more reliable because it would be substantially less constrained by restrictions to protect fish from diversion effects in the Delta and because the CVP and SWP facilities could be operated with more flexibility.

Diversions would be made at times and at the locations that cause the least environmental harm and could reduce diversion volume directly from the Delta by approximately 50 %, thereby approximately doubling residence time in Delta aquatic habitats. Water would be diverted at approximately 5 locations, one or more of which would be in the North Delta on the Sacramento River. Water would be diverted on an ongoing basis for transport to the export pumps. During storm events water would be diverted onto islands for both transport to the pumps and for storage on the islands until needed. Water stored on these islands could be used for exports or for Delta outflow.

Water supply reliability would be improved due to the extra storage capacity provided by the islands, and by relocating and increasing the number of diversion locations to reduce entrainment impacts. Water quality would be improved by the relocation of the primary intake to the North Delta. Reduced Delta inflow that currently dilutes pollutants would be matched by reduction in the pollutant load entering the Delta in the San Joaquin River. Increased flood protection would be provided around the chain of lakes and on other Delta islands.

The system would be operated as follows:

- The chain of lakes would consist of a series of Delta islands linked by siphons, existing channels, or new channels constructed across islands to the CVP and SWP export pumps. The total storage capacity would be approximately 300-600K acre-feet. Combined intake capacity would equal approximately 25K cfs (5 screened intakes at 5K cfs each). One intake would be located in the North Delta, one at the Clifton Court Forebay, and the remaining at various locations on the islands.

- The multiple diversion locations would allow diversions at times and locations that cause the least environmental harm. Water would be diverted for storage onto the islands during winter storm events when there is considerable water in the Delta and when fish generally aren't migrating through the Delta. The stored water would be released during periods of high environmental sensitivity and during the spring and summer as needed either for exports or for Delta outflow. The island system might be filled and lowered several times within a given year.

- Upstream reservoirs would have increases in amount of stored water because of increased diversion opportunities and Delta storage provided by this alternative. Any increased yield could be balanced between increased environmental flows and increase in reservoir carryover storage. New, more protective, environmental standards could be set for the Delta, based upon the new flexibility:

Key Actions

Construct Isolated Transfer and Storage Facility in the Delta (Chain of Lakes)—Convert a series of islands into a storage/conveyance facilities. Screened diversion capacity between approximately 5 diversion points would total approximately 25,000 cfs and storage would total approximately 300,000 to 600,000 acre-feet.

Increase Diversion Rate Capacity—Obtain approvals for fully utilizing existing export capacity during times of lower environmental sensitivity, such as the winter months, so that diversions can be reduced during times of greater sensitivity such as late spring and early

Construct Additional Storage Connected to Export Canals—Construct or expand off stream storage connected to the export canals (e.g., enlarge Los Vaqueros Reservoir or complete East side Reservoir).

Install Barriers—Install barriers to maintain adequate water levels for in-Delta diversions.

Delta Habitat Restoration—Create shallow habitat would be created through levee setbacks or new interior levees. All levee setback programs would be coupled to riparian and shaded riverine habitat restoration on all appropriate new and old levees.

Levee Upgrades—Provide landside buffer zones of 50 to 75 yards to minimize levee subsidence for islands providing valuable existing habitat, such as on Bradford Island. Improve levee maintenance and stabilization to at least National Flood Insurance Program standards (NFIP; 100-year flood protection) for all islands, such as Tyler and Mandeville, containing existing infrastructure and/or land use that provides economic benefit to the region. Improve levee maintenance and stabilization to at least Bulletin 192-82 or PL-99 standards (generally considerably more than 100-year flood protection) for critical western Delta islands, such as Brannan-Andrus, Bethel, and Sherman, to reduce risk to critical infrastructure (e.g. Mokelumne Aqueduct, PG&E gas lines, Highway 160) and to reduce risk to export water quality from salinity intrusion due to levee failure. A levee management plan would provide necessary funding for ongoing maintenance and emergency funding and direction to reclaim Delta islands in the event of inundation in order to continue protection of Delta functions as an integrated resource system

Relocate Diversions -- Relocate export diversions to multiple locations along the new isolated transfer/storage facility. Provide multiple points of diversion, so that with real time monitoring of fish migrations, diversion locations can be selected to minimize impacts on migrating fish.

Control Predators -- Harvest predators at Delta and upstream diversions, holding areas, and other environmentally sensitive areas in the Sacramento and San Joaquin river basins.

Reclamation -- Reclaim agricultural, municipal and industrial wastewater for a variety of uses, improving water quality by reducing wastewater discharges.

Manage Drainage/Discharges -- Impose in-Delta and upstream cropping and irrigation practices to increase the effectiveness of chemical applications to reduce nonpoint source leaching volumes and concentrations. Improve drainage timing for dilution during high flow periods to reduce instream impacts. Set pollutant load limits in the San Joaquin and Sacramento Rivers. Prevent toxic discharges from industrial plants using stronger enforcement, especially during environmentally sensitive periods.

Preliminary Assessment

Ecosystem Quality -- This alternative would provide significant improvements to the ecosystem by reducing entrainment impacts on fish and fish food. Entrainment impacts would be reduced by the relocation of the principal diversion to the North Delta, the use of real-time monitoring and multiple intake locations to minimize entrainment impacts, and the screening of all new diversions. It would also have system benefits by increasing the residence time of water in the Delta, boosting estuary productivity.

Water Supply -- This alternative would provide significant improvements for water supplies. Greater flexibility in location of diversions, greater instantaneous diversion capacity, short term storage (Delta islands), longer term storage (off stream storage), and access to Sacramento supplies with reduced pumping restrictions should allow for significant improvements in export supplies.

Water Quality -- This alternative improves export water quality through relocating export diversions upstream of the Delta, and by providing additional storage. Water quality in the south Delta would be improved by reducing pollutant loads in the San Joaquin River.

System Vulnerability --Constructing an isolated conveyance facility essentially eliminates the risk that water supply exports will be interrupted by a failure of in-Delta facilities. Improvement of levees around Delta islands protects land use, infrastructure, and habitat on those islands.

Alternative WS-12

Group
Water Supply

Title
Improved Through-Delta Conveyance with Screened Diversion at Hood

This alternative is developed around improving the existing through-Delta transport of water in combination with the installation of a fish screen at a relocated diversion point on the Sacramento River near Hood. This alternative is intended to achieve substantially greater protection of anadromous fish and some greater protection for resident fish from entrainment effects, improved aquatic habitat productivity in the Delta, and a more reliable and higher quality supply of water for export from the Delta.

The screening of the Sacramento diversions to the central Delta would provide substantial reductions in the mortality rate of downstream migrating salmon in the Sacramento River. The increased through-Delta flows increases lower San Joaquin River flows (eliminates reverse flows), which reduces entrainment effects on resident fish. Through-Delta channel improvements would include habitat restoration elements. Further habitat restoration in the Delta would improve rearing habitat for anadromous and resident fish. These improvements are needed because the intake points would remain at current locations in the Delta, and would be effective because improved through-Delta flows would decrease the vulnerability of Delta fish to entrainment effects. The water supply would be more reliable because it would be substantially less constrained by pumping restrictions to protect fish from entrainment in the Delta. Export water quality may be somewhat improved because of reduced mixing with high-salinity Bay water. Flood protection throughout the Delta would be improved to protect existing land uses and infrastructure and to protect Delta water quality.

Key Actions

Construct a screened diversion facility at Hood—Divert up to 12,000 cfs of Sacramento River water into the North and South Mokelumne rivers at Hood, increasing the flow and improving the water quality of the San Joaquin River below the Mokelumne River confluence. Improvements to existing through-Delta conveyance channels would improve the efficiency of water movement to the export facilities, reducing entrainment effects and improving water quality in the south Delta.

Delta Islands Habitat Restoration and Subsidence Control—Acquire Delta island properties from willing sellers, convert land use to diverse and permanently flooded wildlife habitat to minimize or reverse subsidence in the west Delta. Also acquire Delta island and tract properties from willing sellers within the 100 year flood plain for creation of tidal and seasonal wetlands, creation of diverse riparian and uplands habitats, and providing flood storage areas to compensate for increased flood flows due to watershed urbanization. Because export intakes would remain at existing locations in the south Delta, these habitat restoration measures would be implemented at high levels.

Increase diversion capacity—Installing an additional gate on Clifton Court Forebay and obtain permits to pump at full export capacity when flows are high and entrainment risks are low, as determined by real-time monitoring.

Improve channel capacity of the north and south Delta—Implement dredging, levee setbacks, and gradient control facilities to improve channel capacity.

Levee Upgrades—Provide landside buffer zones of 50 to 75 yards to minimize levee subsidence for islands providing valuable existing habitat, such as on Bradford Island. Improve levee maintenance and stabilization to at least National Flood Insurance Program standards (NFIP; 100-year flood protection) for all islands, such as Tyler and Mandeville, containing existing infrastructure and/or land use that provides economic benefit to the region. Improve levee maintenance and stabilization to at least Bulletin 192-82 or PL-99 standards (generally considerably more than 100-year flood protection) for critical western Delta islands, such as Brannan-Andrus, Bethel, and Sherman, to reduce risk to critical infrastructure (e.g. Mokelumne Aqueduct, PG&E gas lines, Highway 160) and to reduce risk to export water quality from salinity intrusion due to levee failure. The upgrades to levees would be accompanied by restoration on and adjacent to these levees, providing a mix of shaded riverine aquatic, wetland, and terrestrial habitats. A levee management plan would provide necessary funding for ongoing maintenance and emergency funding and direction to reclaim Delta islands in the event of inundation in order to continue protection of Delta functions as an integrated resource system.

Supporting Actions

Real time monitoring—Implement intensive sampling of fish distribution and abundance to help operate diversion facilities to minimize fisheries impacts.

Close Delta Cross Channel—The Delta Cross Channel would be closed with locks installed to allow boat traffic but prevent the movement of fish into the central Delta.

Control introduced and nuisance species—Implement programs to reduce the likelihood of introducing exotic species and to combat the deleterious effects of those which have become established.

Preliminary Assessment

Ecosystem Quality—Habitat restoration actions would be implemented near the maximum level in this alternative because the export pumps would remain in the south Delta. Additional improvements to ecosystem quality would be achieved through reducing diversion and reverse flow impacts currently associated with Delta exports. Consequently, productivity improvements would be expected in the western Delta and lower San Joaquin River. Losses of anadromous and resident fish from the Sacramento River, Suisun Bay and the Delta to exports at the south Delta pumping plants would be reduced. This alternative would provide less protection from diversion impacts than an isolated transfer facility, so it would require more habitat restoration in the Delta. Continued losses of Delta resident, and San Joaquin and Delta anadromous fish would still occur at the export pumps.

Water Supply—Under this alternative, 1995 Water Quality Control Plan objectives would remain in place. However, the improved through-Delta conveyance may allow a relaxation of export/inflow rules, thus providing a more reliable and higher quality water supply.

Water Quality—Water quality will be enhanced to varying levels for areas receiving Delta export water, as well as in-Delta diverters because of the greater isolation of export water from sea water intrusion and more dilution of Delta agricultural drainage. This alternative provides more dilution of south Delta water by Sacramento River water, reducing the need for San Joaquin River pollutant controls.

System Reliability—The system reliability would be increased within the Delta due to the more stable levees in the Mokelumne River system. Western Delta habitat restoration and levee maintenance would also improve system reliability.

Possible Supplemental Actions

A fish barrier at Georgianna Slough could be installed to increase the protection of Sacramento River fish. Tidal barriers in the south Delta could be used to further improve south Delta water supply, if needed. Improve anadromous fish survival by providing passage through upstream obstructions and by opening alternative migration routes and reducing upstream diversions (including the Keswick Canal).

Alternative WS-13

Small Isolated Transfer Facility - Delta Channel Improvements (Dual Transfer Facility)

This alternative focuses on reducing diversion effects on fish and providing a more reliable water supply from the Delta, primarily through relocation of M&I export diversions, increased through Delta conveyance, and moderate levels of habitat restoration.

A small, isolated transfer facility is included to connect the relocated diversion on the Sacramento River to Clifton Court Forebay. The improvements in through Delta conveyance capacity, coupled with increase diversion rate capacity increases opportunity for diversions. The relocated diversion also improves the water quality of exports, and reduces constraints on M&I exports associated with entrainment of fish. Ecosystem benefits include increased habitat value and decreased losses of anadromous and Bay-Delta native fish. Delta water quality is improved through improved Delta circulation, by reducing pollutant loading of the Delta via the San Joaquin River, and through agricultural, industrial, and municipal wastewater reclamation and reuse. The isolated facility essentially eliminates the vulnerability of M&I export supplies to catastrophic failure. The vulnerability of Delta land use, Delta water supply, agricultural export water supply and Delta ecosystem function to catastrophic failure is reduced by improving levees throughout the Delta.

Key Actions

Construct Small (M&I) Isolated Transfer Facility—Construct a new isolated transfer facility from the Sacramento River between Freeport and Walnut Grove to Clifton Court Forebay with a capacity of 5000- 8,000 cfs. Provide best available fish screening technology at the new diversion and use real time monitoring to help operate the diversion to minimize fisheries impacts. This relocation of the diversion point significantly reduces the number of fish (especially resident Delta species) exposed to the diversion, the length of time fish are exposed to the diversion, and reduces rerouting of migrating fish caused by flow circulation associated with export pumping. The new diversion point also provides access to higher quality water for export than the existing diversion location.

Channel Capacity Improvements—Improve channels of the north Delta area with dredging, levee setbacks, and gradient control facilities. Improvements to existing through-Delta Conveyance channels would improve the efficiency of water movement to the export facilities for times when exports exceed the capacity of the small isolated transfer facility, thereby reducing fishery entrainment effects and improving water quality in the south Delta.

Increase Diversion Rate Capacity—Install additional gate on Clifton Court Forebay and obtain permit to pump at full export capacity under appropriate conditions.

Levee Upgrades—Establish long-term cost-shared levee maintenance program to provide improved flood protection and system reliability. Provide landside buffer zones of 150 to 300 feet to minimize levee subsidence for islands with deep peat soil. Improve levee maintenance and stabilization to at least PL-99 standards (generally considerably more than 100-year flood protection) for all islands.

Restore Delta Island Habitat—Acquire Delta island properties from willing sellers, convert land use to diverse and permanently flooded wildlife habitat to minimize or reverse subsidence in the west Delta. Also acquire Delta island and tract properties from willing sellers within the 100 year flood plain for creation of tidal and seasonal wetlands, creation of diverse riparian and uplands habitats, and providing flood storage areas to compensate for increased flood flows due to watershed urbanization.

Supporting Actions

Install South Delta Barriers—Construct barriers on Old River, Grant Line Canal, and Middle River to address water level and water quality impacts of exports from the south Delta.

Riparian and Wetland Habitat Restoration—Portions of some Delta islands or tidelands would be restored to provide substantial increases in brackish and tidal marshes; riparian woodlands; and waterfowl breeding, wintering, and feeding habitat. Substantial shoreline areas would be restored to increase shallow and shaded riverine, and tidal slough habitat. Emphasis would be placed on restoring shoreline habitats along Delta levees that require upgrading and protection. Because this alternative would retain the current south-Delta location of the export pumps, restoration efforts would be focused principally on the northern and western Delta and Suisun Bay away from the direct influence of these pumps. Where cost effective, construct water-side berms and construct setback levees to create riparian and wetland habitat.

Fish Passage Improvements—Improve anadromous fish survival through improved habitat, providing passage through obstructions, through improved water quality, and opening alternative migration routes.

Reclamation—Reduce pollutant loading via the San Joaquin River and reclaim agricultural, municipal and industrial wastewater for a variety of uses, improving water quality by reducing wastewater discharges.

Control Introduced and Nuisance Species—Implement programs to reduce the likelihood of introducing exotic species and to combat the deleterious effects of those which have become established.

Preliminary Assessment

Ecosystem Quality—The M&I isolated transfer facility and through-Delta conveyance improvements in this alternative would greatly reduce diversion impacts on Sacramento River anadromous fish and all fish at Clifton Court Forebay. They would also reduce the reverse flow impacts currently associated with the export pumps. Consequently, improvements in ecosystem

productivity would be expected in the western Delta and lower San Joaquin River. Complementary restoration actions, implemented at moderate levels, would increase the extent and quality of habitat, principally in the north and west Delta. Diversion impacts associated with in-Delta diversions and the export pumps could be further reduced by screening the diversion location for the through-Delta flow of water. Terrestrial and avian species would also benefit through the creation of wetlands and riparian zones. Losses of agricultural lands would need to be mitigated through enhancement on selected existing agricultural lands.

Water Supply—Key and supporting actions will substantially improve water supply reliability and flexibility, through increased opportunity for diversion and through facilities less vulnerable to seismic damage. The M&I water supply component would achieve an acceptable level of reliability. A distributed intake system would reduce vulnerability to shutdown due to aquatic impacts.

Water Quality—High quality M&I water from the Sacramento River would be assured. South and west Delta water quality would be improved due to reduced agricultural return flow from islands converted to wildlife habitat and from improved cross Delta flow. This option could provide a high quality secure source of supply for SWP south of Delta M&I as well as EBMUD and San Joaquin County.

System Reliability—There would be modest gains in delta levee reliability, due to the levee maintenance programs, riparian berms, channel improvements, setback levees, and subsidence control/reversal measures. Most of the Delta levees would be significantly less vulnerable to failure from flooding. The M&I water supply system would achieve much greater reliability.

Alternative WS-14

Group
WATER SUPPLY

Title
West-side Sacramento Storage and Conveyance Facility

The purpose of this alternative is to develop the full potential of the available water and fisheries resources located in and upstream of the Delta. The concept is to provide additional water supplies to the Delta during critical periods by diverting, storing, and conveying a percentage of flood waters that now flow out to sea. Major diversions now impacting fisheries would be relocated and consolidated to upstream locations that would reduce or eliminate the fisheries impacts and improve the water quality of the water diverted. Flood flows would be stored in new carry over storage facilities that would provide a higher degree of water supply reliability and flexibility of system operation of existing reservoirs. The conveyance system would link and offer flexibility for conjunctive use between surface and groundwater storage and urban, agricultural, and environmental beneficial uses. The conveyance system would terminate at the current south Delta pumps, thus eliminating the impacts of pumping on the south Delta. Habitat restoration, and enhancement in the Delta and River system and tributaries would be developed in consort with the new operational flexibility of the existing and the new reservoirs to enhance fish and wildlife. Vulnerability of Delta functions to catastrophic failure would be protected by the new facility in combination with flood way and levee improvement.

Diversion conduits from Shasta Lake and Lake Oroville would be used to convey a small fraction of the flood flows to reservoir sites for "banking" on the west side of the Sacramento valley. Water would be diverted only when the reservoirs are spilling. New storage reservoirs along the west side of the Sacramento valley could have stored 13 million ac-ft of additional water from Shasta lake flood releases could have been banked from 1971 to 1992. With a cross-valley conduit from Oroville to the west side reservoirs this concept could add approximately 2 million acre feet to the Delta water supply in an average year. Water released from the west-side reservoirs could also assist out migration of fish at critical time.

Key Actions

Consolidate and relocate diversions—Construct new diversions at Shasta Lake and Lake Oroville forebay with capacities to capture significant wet weather flows that would other wise must be released. For this alternative the diversion at Shasta would range 5,000 to 10,000 cfs while Oroville's capacity would range from 2,000 to 7,000 cfs.

Develop additional off-stream storage—Develop approximately 10 million ac-ft of new storage capacity at off-stream reservoir sites on the westside streams between Shasta and Lake Berryessa. Potential reservoirs such as the Colusa-Sites would be linked together by a new westside conveyance system. The reservoirs would be operated to supply Westside agricultural irrigation water, and exports from the Delta for agriculture, municipal and industrial uses and to the Sacramento River and tributaries environmental beneficial uses.

Develop conveyance facilities—Develop conveyance facilities to connect the diversions to west-side storage facilities. From the storage facilities connect to the Tehama-Colusa Canal, Glenn-

Colusa Irrigation District, possibly the North Bay Aqueduct, and a cross-Delta Transfer facility. Provide turnouts to stream flow augmentation points and to groundwater conjunctive use areas on the west and east sides of the valley.

Construct an isolated west-side cross-Delta Facility—Construct an isolated conveyance system that connects the west-side storage projects to the California Aqueduct and the Delta Mendota Canal. The capacity of the facility would approximately equal that of the California Aqueduct and Delta Mendota Canal combined. (Around 15,000 to 20,000 cfs)

Modify reservoir operations—Reoperate Shasta Reservoir and Oroville Reservoir to provide high flow diversion to Westside storage facilities and to manage flows and temperatures in river fisheries habitats.

Upstream Habitat Restoration—Additional upstream storage will provide opportunity for improved flow and temperature regulation in Sacramento River and Westside tributaries. Restoration of upstream habitats also would rely on core-level implementation of actions in high priority areas, such as restoring spawning gravels in upstream anadromous fish habitats, restoring sites for riparian vegetation, and improving fish passage at upstream barriers.

Bay-Delta Habitat Restoration—Restoration of Bay-Delta habitats would rely on core-level implementation of actions such as protecting existing shallow water habitat from erosion, restoring riverine habitat on channel islands, enhancing existing riparian and wetland habitats, and improving efforts to prevent further introduction of undesirable exotic species.

Encourage groundwater banking and conjunctive use—In order to maximize the opportunity for groundwater reclamation and recharge, and conjunctive use with the west-side surface storage, encourage and provide the conveyance facilities to aquifers such as the Butte Creek and Stoney Creek Basins .

Channel and floodway habitat improvement—Expand floodway habitat, channels, and meander belts in the Bay-Delta and in the rivers and the tributaries upstream of the Delta to restore fish spawning, rearing, feeding habitats, and improve fish survival.

Fish Screens—Install fish screens on the remaining diversions that divert over 100 cfs and are on fish migration routes.

Management of Water Quality—This alternative would rely on core actions which include implementing watershed source controls, strengthening urban, agricultural, and mining discharge controls, improving pest-control practices, and better management of dredging operations.

Levee Upgrades—Provide landside buffer zones of at least 75 yards to minimize levee subsidence and improve levee maintenance and stabilization to at least hazard mitigation plan standards (HMP; a level of protection less than the 100-year flood) for islands providing valuable existing habitat, such as on Bradford Island. Improve levee maintenance and stabilization to at least National Flood Insurance Program standards (NFIP; 100-year flood protection) and to maximum credible earthquake standards (MCE) for all islands, such as Tyler and Mandeville, containing

existing infrastructure and/or land use that provides economic benefit to the region. Improve levee maintenance and stabilization to at least Bulletin 192-82 or PL-99 standards (generally considerably more than 100-year flood protection) and to MCE standards for critical western Delta islands, such as Brannan-Andrus, Bethel, and Sherman, to reduce risk to critical infrastructure (e.g. Mokelumne Aqueduct, PG&E gas lines, Highway 160) and to reduce risk to export water quality from salinity intrusion due to levee failure. A levee management plan would provide necessary funding for ongoing maintenance and emergency funding and direction to reclaim Delta islands in the event of inundation in order to continue protection of Delta functions as an integrated resource system.

Preliminary Assessment

Ecosystem Quality—This alternative would greatly enhance ecosystem quality by eliminating the impacts of the major diversions and providing more opportunity for managing flows and temperature in the Sacramento River and upstream tributaries. The elimination of the export pumps in the south Delta along with habitat restoration and enhancement in the Delta and the river system will improvement fish production.

Water Supply Reliability—This alternative would improve water supply reliability by providing additional storage for critical periods for Urban, Agriculture and Environmental uses. Around 2 million ac-ft of new supply would be available to the Delta.

Water Quality—The water quality of exports would be greatly improved from the diversion of higher quality in the upstream areas. The water quality of the Delta would be slightly improved because of the elimination of the export pumps and the implementation of water quality management of core actions.

System Reliability—This alternative would achieve some improvements in system reliability through the implementation of core actions. Additional system reliability actions may be needed to achieve more significant improvements.

Alternative WS-15

Group
Water Supply

Title
Eastside M&I Conveyance Facility

This alternative envisions a new conveyance facility, located along the east side of the Sacramento and San Joaquin Valleys, connecting intakes on the Sacramento, Feather, American, and all other east-side rivers to the California aqueduct at the Edmonston pumping plant. The purpose of this alterative is to increase populations of anadromous and Bay-Delta native fish by relocating M&I export diversions upstream of the Delta and by improving instream habitat. This alternative would also greatly improve the reliability and quality of M&I exports, and would make them less vulnerable to catastrophic failures.

This alternative would divert water from the upper Sacramento River and transport it in a canal to southern California. The facility would be sized (5000 cfs at its terminus) to meet M&I export and agricultural conjunctive use demands. The diversion impacts associated with the export of M&I water from the south Delta would be eliminated. Interties with eastside rivers such as the Mokolumne, the Tuolumne and the Stanislaus would be included, benefits would also accrue to Bay Area M&I water users. The existing Folsom South, Madera, Friant-Kern, and Cross Valley canals would be modified or paralleled to convey high quality M&I supplies to the California Aqueduct and groundwater banking facilities in the San Joaquin Valley. Instream flow requirements would be maintained in eastside rivers by substituting canal water for agricultural diversions from these rivers. The eastside interies could also be used to facilitate transfers of water from eastside streams. Water from the canal would be used to recharge groundwater basins on a continuous basis for conjunctive use. The vulnerability of Delta land use, Delta water supply, agricultural export water supply and Delta ecosystem function to catastrophic failure is reduced by improving levees on eight critical western islands, and elsewhere within the Delta.

Reduction in instream flows in the Feather and American Rivers would be compensated by the restoration of in-channel habitats. The increased conveyance capacity provided by the canal would result in an increased water supply (by providing the opportunity to divert more water during periods of storm flow. Some of this water could be used for environmental purposes.

Key Actions

Construct East Valley Conveyance Facility—Relocate M&I export diversions to the Sacramento River upstream of the Feather confluence, and to the Feather at Thermalito. Construct a new conveyance facility from these points south, along the east side of the Sacramento and San Joaquin Valleys, connecting to the California Aqueduct in Kern County. Enlarge and modify the existing Folsom South, Madera, Friant-Kern, and Cross Valley Canals as feasible to serve as parts of the new conveyance. Size the facility to meet M&I export needs, including supplemental dry year supplies for EBMUD and Hetch Hetchy; environmental needs in the San Joaquin River; groundwater recharge and banking in the eastern San Joaquin County to improve M&I supply reliability and to make dry period water available for environmental uses in the Delta and its tributaries. This would eliminate diversions for M&I purposes in the Delta, reducing diversion impacts.

Delta Habitat Restoration and Subsidence Control—Acquire Delta island properties from willing sellers, convert land use to diverse and permanently flooded wildlife habitat to minimize or reverse subsidence in the west Delta. Also acquire Delta island and tract properties from willing sellers within the 100 year flood plain for creation of tidal and seasonal wetlands, creation of diverse riparian and uplands habitats, and providing flood storage areas to compensate for increased flood flows due to watershed urbanization. Because agricultural water export intakes would remain at existing locations in the south Delta, these habitat restoration measures would be implemented at moderate levels.

Upstream Habitat Restoration—To compensate for reductions in instream flows, in-channel habitat restoration would be undertaken along the Feather and American Rivers. A variety of habitat types including spawning substrate, shaded riverine; riparian, wetland and terrestrial habitats would be restored.

Levee Upgrades—Provide landside buffer zones of 50 to 75 yards to minimize levee subsidence for islands providing valuable existing habitat, such as on Bradford Island. Improve levee maintenance and stabilization to at least National Flood Insurance Program standards (NFIP; 100-year flood protection) for all islands, such as Tyler and Mandeville, containing existing infrastructure and/or land use that provides economic benefit to the region. Improve levee maintenance and stabilization to at least Bulletin 192-82 or PL-99 standards (generally considerably more than 100-year flood protection) for critical western Delta islands, such as Brannan-Andrus, Bethel, and Sherman, to reduce risk to critical infrastructure (e.g. Mokelumne Aqueduct, PG&E gas lines, Highway 160) and to reduce risk to export water quality from salinity intrusion due to levee failure. The upgrades to levees would be accompanied by restoration on and adjacent to these levees, providing a mix of shaded riverine aquatic, wetland, and terrestrial habitats. A levee management plan would provide necessary funding for ongoing maintenance and emergency funding and direction to reclaim Delta islands in the event of inundation in order to continue protection of Delta functions as an integrated resource system.

Supporting Actions

Fish Passage Improvements—Improve anadromous fish passage at high priority small dams and other barriers in the Sacramento and San Joaquin river basins (about 50 percent of all small structures).

Reservoir Operations—Change reservoir operations to supply the canal, maintain instream flows and provide fish transport flows.

Manage Drainage/Discharges—Pollutant loads in the San Joaquin River would be reduced by approximately 50% to offset the loss of dilution water from the Sacramento River. A variety of methods for achieving this goal would be applied, but the program would focus on land retirement.

Control Induced/Nuisance Species—Reduce the numbers of aquatic predators from key habitat and modify habitat to limit introduced/nuisance species.

Conjunctive Use of Groundwater—Implement a conjunctive use program in the San Joaquin Valley that uses water from the eastside to recharge groundwater basins. During the irrigation season, this groundwater would be used instead of water diverted from eastside streams. Alternatively, groundwater could be pumped into the canal during dry periods to allow water to reduce demands on the Sacramento, Feather and American River reservoirs.

Preliminary Assessment

Ecosystem Quality—Habitat restoration actions would be implemented at moderate levels in this alternative because agricultural exports would continue to be diverted from the south Delta, but M&I exports would be moved from the Delta. Additional improvements to ecosystem quality would be achieved through reducing diversion and reverse flow impacts currently associated with Delta exports. Consequently, productivity improvements would be expected in the western Delta and lower San Joaquin River. Losses of anadromous and resident fish from the Sacramento River, Suisun Bay and the Delta to exports at the south Delta pumping plants would be reduced. This alternative would provide similar protection from diversion impacts as the small isolated transfer facility, so it would require similar habitat restoration in the Delta. However, losses of instream flows in Feather and American Rivers would be compensated through habitat restoration and supplemental environmental flows. Continued losses of Delta resident, and San Joaquin and Delta anadromous fish would still occur at the export pumps, though at a reduced level.

Water Supply—M&I water users in the Bay Area and southern California would have improved supply reliability and quality. M&I water users in the San Joaquin Valley could benefit form the conjunctive use program. Under this alternative, 1995 Water Quality Control Plan objectives would remain in place to protect in-Delta users..

Water Quality—Water quality will be enhanced to varying levels for areas receiving Delta export water. M&I users would receive higher quality water from the Sacramento, Feather and American Rivers. In-Delta water users would benefit from the reduction in pollutant loads in the San Joaquin River.

System Reliability—The system reliability would be increased within the Delta due to the more stable levees in the Delta system. The canal would also provide a more reliable source of water to some M&I users. Delta habitat restoration and levee maintenance would also improve system reliability.

Possible Supplemental Actions

A fish barrier at Georgianna Slough could be installed to increase the protection of Sacramento River fish. Tidal barriers in the south Delta could be used to further improve south Delta water supply, if needed. Improve anadromous fish survival by providing passage through upstream obstructions and by opening alternative migration routes and reducing upstream diversions (including the Keswick Canal).

Alternative WS-16

Group
Water Supply

Title
Water Transfers With Existing Pumping Capacities

This alternative focuses on increasing the reliability of the system (both for export and environmental needs) through reliance on water transfers originating from upstream of the Delta. This alternative also focuses on avoiding developing new in-Delta conveyance or storage facilities. The implementation of this alternative will maximize water transfers to the extent possible without state or federal involvement in developing new sources for transfers. Source water for transfers will be developed from willing sellers in the Sacramento and San Joaquin valleys. The availability of transfer water will be dependant on the level of local management programs to develop transferrable supplies. Current regulatory requirements for water transfers will be modified to ease the implementation and approval process. The export criteria during the months of February though June would be increased to allow more adaptive management of export diversions during high winter and spring flows. Changes in the export criteria and associated changes in the permitted diversion capacity of the SWP and CVP pumping plants will increase the yield from the Delta.

In addition to exporting more water in the winter and spring runoff period, this alternative will move more water through the Delta in the July through October period when capacity to export water exists under current standards. To offset increases in export pumping, an intensive adaptive management program will be implemented, along with a high level of in-Delta habitat restoration. The adaptive management program will monitor the success of various restoration programs, fish screening and salvage programs, and water movement through the Delta. Due to the continued reliance on Delta exports, at their current location, this alternative would also emphasize a levee maintenace and improvement program to protect against disruption of the export system.

Key Actions

Delta Export Criteria— Change Delta export criteria to enable greater exports during periods of high Delta inflow. Under this alternative the 35 percent export ratio during February through June, and the May 15 through April 15 restrictions relative to San Joaquin flows would be increased to accommodate greater exports. Reducing the restrictions on exports during this period would increase the yield from the Delta. The additional yield could be stored in a number of existing south of Delta reservoir facilities.

Water Transfers— Increase the utilization of water transfers from existing sources to meet the needs of the SWP/CVP and the environment. Transfers will be coordinated to

release transfer water during periods and at rates that benefit fisheries and utilize available export capacity. To ease the implementation of water transfers a programmatic environmental impact statement (PEIS) would be prepared to define criteria for transferring water through the Delta. The PEIS would also identify appropriate and streamlined refill impact criteria.

Groundwater Banking— Provide additional insurance for drought conditions with groundwater banking programs, particularly to the south of the Delta. New or expanded groundwater storage facilities in the San Joaquin and Tulare basins could be developed to store water for drought use. Additional groundwater banking facilities should also be developed in the Southern California area. Water for storage in these facilities would be developed from increases in exports from the Delta and water transfers during periods of sufficient water supplies to the Delta.

Delta Cross Channel Gate Operations— Modify existing operating criteria for the Cross Channel gate to allow the gates to be open during the February through June period. Allowing the gates to remain open will increase the flow into the south Delta and reduce the possibility of reverse flow conditions in the western Delta.

Migration Barriers— Install fish migration barriers at Georgiana Slough and the Delta Cross Channel to reduce fish entrainment in the interior Delta. Migration barriers, acoustic or otherwise, will also allow the Delta Cross Channel to be open during February through June when out-migrating salmon are present. The ability to keep the Delta Cross Channel gates open will increase flows to the south Delta to improve the ability to export water.

Levee Improvements— Due to the continued export operations in the south Delta, a levee maintenance program would be implemented that will maintain and increase, where appropriate, levee stability and protection levels. A program should also be implemented to modify levees, as appropriate, to provide shallow water habitat and improve riparian habitat.

Reduce Fish Entrainment and Losses at CVP and SWP Facilities— Reduce entrainment and mortality of fish salvaged at Banks and Tracy pumping plants. Measures to reduce entrainment and losses should include:

- Increase diversion screen efficiencies.
- Improve fish salvage and handling.
- Monitor entrainment on a real time basis to identify periods of peak susceptibility of various species.
- Improve predator control at both facilities.
- Coordinate operations of two diversions, including interchangeable pumping, to reduce combined losses.

Hatchery Management—Improve hatchery production for various fish species that use the Bay-Delta Estuary. Improved hatchery production and coordination would serve to: mitigate the loss of stream spawning and rearing habitat; mitigate increasing harvest pressures; and provide short term support for various species until other programs to improve fish survival and habitat conditions are implemented.

Adaptive Management Programs— Develop adaptive management programs for efficient operations of the Delta Cross Channel, migration barriers, export and Delta outflows, fish salvage operations and hatchery programs. An adaptive management program should consider the appointment of a Delta water master to oversee the effective management of Delta programs related to movement of water for export, local diversion, and environmental needs. To ensure genetic diversity hatchery production should be practiced to compliment, not replace, measures to improve the natural production and survival of fish species.

Delta Habitat Restoration— Develop an intensive program of habitat restoration that would improve the availability of riverine, riparian, wetland, and terrestrial habitat within the Delta. These habitat improvements would be focused on increasing the natural productivity and survival of species that rely on the Bay-Delta Estuary.

Preliminary Assessment

Ecosystem Quality— Core habitat restoration actions would be implemented near the maximum levels within the Bay-Delta Estuary and on the Sacramento and San Joaquin Rivers. The habitat measures undertaken as part of this alternative would improve habitat availability and quality. Because this alternative is focused on retaining the south Delta export facilities and increasing the volumes of water exported from Delta, habitat and ecosystem restoration measures in the Delta would be focused on reducing the impacts of diversions and reverse flows associated with Delta exports.

Water Supply— This alternative would rely on exporting greater volumes during winter and spring periods, which are currently restricted by permits and Bay-Delta standards. Changes to the 1995 Bay-Delta Plan, specifically increasing the export ratio during February through June, would allow for additional water to be exported, increasing the yield from the Delta. The additional yield could be stored in existing surface reservoirs to the south of the Delta and in groundwater banking facilities. However, without developing additional storage facilities south of the Delta, benefits of these changes are somewhat limited by existing capacity.

The reliance on water transfers in this alternative would be only moderately aggressive. In this alternative water transfers would be sought by the SWP and CVP for supply and environmental needs from willing sellers. Neither the SWP nor CVP would develop new supplies to be available for transfer. Based on recent transfers between water districts and

transfers associated with the Drought Water Bank it is estimated that about 200,000 acre-feet could be available for transfers from the Sacramento and the San Joaquin valleys.

Water Quality— Water quality will be improved through implementation of core actions. Key actions implemented to the maximum levels feasible will be to control agricultural drainage. Changes in agricultural drain management to reduce the overall pollutant loads of the system will be perferred, including modifications to agricultural practices to reduce the discharge of pollutants.

System Reliability— The reliability of water supplies for the SWP, CVP and the environment will only be moderately improved by this alternative. This alternative does not attempt to develop long-term supply reliability. While transfers can be plentiful in the near future and in particular water types, their availability will be affected by continued urban development in areas upstream of the Delta. System vulnerability is improved in this alternative, above the current levels. Because this alternative continues to rely on water exports in the south Delta, the level of levee protection will be increased to an appropriate level to reduce the risk of catastrophic failures that would interrupt supply availability.

Alternative WS-17

Group
Water Supply

Title
Develop Transfer Supplies With Additional South of Delta Storage

This alternative focuses on increasing the reliability of the system (both for export and environmental needs) through developing sources for water transfers from the Sacramento and San Joaquin valleys. This alternative will increase channel capacities across the Delta but avoids developing new in-Delta conveyance or storage facilities. The implementation of this alternative will maximize water transfers by developing conjunctive use programs which will make transfers sources more available. Conjunctive use programs will be monitored to ensure efficient use of existing groundwater resources and long-term protection of the resource. The export criteria during the months of February though June would be increased to allow more adaptive management of export diversions during high winter and spring flows. The export criteria and the permitted diversion capacity of the SWP and CVP pumping plants will be increased to full capacity of the facilities. A new moderately sized off-storage facility (200-300 TAF) will be develop along the west side of the San Joaquin Valley to regulate water diverted from the Delta. This new facility will regulate water seasonally to users as well as to groundwater banking facilities.

In addition to exporting more water in the winter and spring runoff period, this alternative, will move more water through the Delta in the July through October period when additional capacity will be available. To offset increases in export pumping, an intensive adaptive management program will be implemented, along with a high level of in-Delta habitat restoration. The adaptive management program will monitor the success of various restoration programs, fish screening and salvage programs, and water movement through the Delta. Due to the continued reliance on Delta exports, at their current location, this alternative would also emphasize a levee maintenance and improvement program to protect against disruption of the export system.

Key Actions

Delta Export Criteria— Change Delta export criteria to enable greater exports during periods of high Delta inflow. Under this alternative the 35 percent export ratio during February through June and the May 15 through April 15 restrictions relative to San Joaquin flows would be increased to accommodate greater exports. Reducing the restrictions on exports during this period would increase the yield from the Delta. The additional yield could be stored in a number of existing south of Delta reservoir facilities.

Water Transfers— Develop transferrable supplies from well integrated conjunctive use programs. Conjunctive use programs will be developed in the Sacramento and San

Joaquin Valleys to develop dependable transfer supplies. The program will provide assistance to local agencies to develop groundwater resources and participate in surface water and groundwater substitution programs. Conjunctive use programs will also be monitored to ensure that basins are not over drafted or water quality is not degraded. It is estimated that such a program could yield up to 400 TAF of annual supply. Transfer water would be secured through a fallowing program that can be implemented during drought periods. To ease the implementation of water transfers a programmatic environmental impact statement (PEIS) would be prepared to define criteria for transferring water through the Delta. The PEIS would also identify appropriate and streamlined refill impact criteria.

Transfer/Conjunctive Use Adaptive Management Program— The conjunctive use and water transfer program developed specifically to increase the availability of transfer water for the SWP, CVP, and environmental needs will be closely monitored to ensure it efficient use and effective long-term management. The program will coordinate timing of water transfers to coincide with in stream fishery needs and upstream of the Delta and capacity of export water from the Delta. The program will also act as a broker to match available transfer supplies with demands.

Groundwater Banking— Provide additional insurance for drought conditions with groundwater banking programs, particularly to the south of the Delta. New groundwater storage facilities in the San Joaquin and Tulare basins could be developed to store water for drought use. Additional groundwater banking facilities should also be developed in the Southern California area. Water for storage in these facilities would be developed from increases in exports from the Delta which would be regulated by an off-stream storage facility.

Delta Cross Channel Gate Operations— Modify existing operating criteria for the Cross Channel gate to allow the gates to be open during February through June period. Allowing the gates to remain open will increase the flow into the south Delta and reduce the possibility of reverse flow conditions in the western Delta. In addition the capacity of the facility will be increased to allow more water to be conveyed to the south Delta.

Migration Barriers— Install fish migration barriers at Georgiana Slough and the Delta Cross Channel to reduce fish entrainment in the interior Delta. Migration barriers, acoustic or otherwise, will also allow the Delta Cross Channel to be open during February through June when out-migrating salmon are present. The ability to keep the Delta Cross Channel gates open will increase flows to the south Delta to improve the ability to export water.

Delta Channel Capacity Improvement— The capacity of Delta channels will be increased to effectively move water from the north Delta to the south Delta. This would include widening some channel capacities and constructing new or expanded channels, such a the

Snodgrass Slough project. Channel modifications will coordinated with habitat and levee improvements where practicable.

Levee Improvements— Due to the continued export operations in the south Delta, a levee maintenance program would be implemented that will maintain and increase, where appropriate, levee stability and protection levels. A program should also be implemented to modify levees, as appropriate, to provide shallow water habitat and improve riparian habitat.

Reduce Fish Entrainment and Losses at CVP and SWP Facilities— Reduce entrainment and mortality of fish salvaged at Banks and Tracy pumping plants. Measures to reduce entrainment and losses should include:

- Increase diversion screen efficiencies.
- Improve fish salvage and handling.
- Monitor entrainment on a real time basis to identify periods of peak susceptibility of various species.
- Improve predator control at both facilities.
- Coordinate operations of two diversions, including interchangeable pumping, to reduce combined losses.

Hatchery Management—Improve hatchery production for various fish species that use the Bay-Delta Estuary. Improved hatchery production and coordination would serve to: mitigate the loss of stream spawning and rearing habitat; mitigate increasing harvest pressures; and provide short term support for various species until other programs to improve fish survival and habitat conditions are implemented.

Delta Adaptive Management Programs— Develop adaptive management programs for efficient operations of the Delta Cross Channel, migration barriers, export and Delta outflows, fish salvage operations and hatchery programs. An adaptive management program should consider the appointment of a Delta water master to oversee the effective management of Delta programs related to movement of water for export, local diversion, and environmental needs. To ensure genetic diversity hatchery production should be practiced to compliment, not replace, measures to improve the natural production and survival of fish species.

Delta Habitat Restoration— Develop an intensive program of habitat restoration that would improve the availability of riverine, riparian, wetland, and terrestrial habitat within the Delta. These habitat improvements would be focused on increasing the natural productivity and survival of species that rely on the Bay-Delta Estuary.

Preliminary Assessment

Ecosystem Quality— Core habitat restoration actions would be implemented near the

maximum levels within the Bay-Delta Estuary and on the Sacramento and San Joaquin Rivers. The habitat measures undertaken as part of this alternative would improve habitat availability and quality. Because this alternative is focused on retaining the south Delta export facilities and increasing the volumes of water exported from Delta, habitat and ecosystem restoration measures in the Delta would be focused on reducing the impacts of diversions and reverse flows associated with Delta exports.

Water Supply— This alternative would rely on exporting greater volumes during winter and spring periods, which are currently restricted by permits and Bay-Delta standards. Changes to the 1995 Bay-Delta Plan, specifically increasing the export ratio during February through June, would allow for additional water to be exported, increasing the yield from the Delta. The additional yield would be stored in existing and new surface reservoirs to the south of the Delta and groundwater banking facilities developed as part of this program. Off-stream storage and groundwater banking facilities will be operated to store excess water in the groundwater banking facility for insurance against drought deficiencies.

The reliance on water transfers in this alternative would be very aggressive. Water transfers would be developed by through a joint state and federal program for supply and environmental needs. This alternative would develop supplies that could satisfy near-term demands for the system. Continued growth in the areas upstream of the Delta will decrease the availability of transfer water developed under this alternative. Likewise, continued growth in the south land will continue to increase the demand for export water, probably beyond supply developed in this alternative.

Water Quality— Water quality will be improved through implementation of core actions. Key actions implemented to the maximum levels feasible will be to control agricultural drainage. Changes in agricultural drain management to reduce the overall pollutant loads of the system will be preferred, including modifications to agricultural practices to reduce the discharge of pollutants.

System Reliability— The reliability of water supplies for the SWP, CVP and the environment will only be moderately improved by this alternative. This alternative does not attempt to develop long-term supply reliability for any need. While transfers can be plentiful in the near future and in particular water types, their availability will be affected by continued urban development in areas upstream of the Delta. System vulnerability is improved in this alternative, above the current levels. Because this alternative continues to rely on water exports in the south Delta, the level of levee protection will be increased to an appropriate level to reduce the risk of catastrophic failures that would interrupt supply availability.

Alternative WS-18

Group
Water Supply

Title
Demand Reduction with Water Transfers

The objective of this alternative is to increase water supply reliability through developing transfer sources and implementing demand management practices in all areas. This alternative will maintain the south Delta export facilities and avoid development of new in-Delta facilities. This alternative will accomplish the following objectives: (1) develop transfer sources that will increase the availability of supplies; (2) increase the available supply through demand management practices, (3) improve management of Delta exports through changes in diversion timing and development of additional off-stream storage linked to south of the Delta conveyance facilities; and (4) develop long-term storage through groundwater management programs in the southern San Joaquin Valley and the Tulare Basin.

This alternative will increase the supply available to urban, industrial, agricultural, and environmental users through a number of programs aimed at remanaging existing supplies and water resources facilities. Managing demand in the export area will reduce the continued growth in demand for export water, while demand management in the areas upstream of the Delta will make more water available for current needs as well as for future growth. Water transfers will help meet both the immediate and long-term need for additional export and environmental water. Through demand management, water transfers, and remanagement of Delta exports, the timing and pattern of exports can be changed away from the critical spring period and increased in more favorable periods to improve spring outflow and reduce diversion impacts. Due to the continued reliance on the south Delta export facilities, this alternative will emphasize protection of key western Delta islands avoid disruption of export operations.

Key Actions

Supplemental Water Transfers— Supplemental transfer supplies will be developed to help the state and federal projects meet their delivery obligations to both contractors and the environment. Supplemental transfer water will be developed from excess surface water stored in local reservoirs and through groundwater substitution or conjunctive use. Supplemental water acquired from surface water sources will be from willing sellers. Water acquired from groundwater sources will be from willing sellers and from new projects. New groundwater substitution or conjunctive use projects will be developed by the state or federal projects where there are adequate resources. It is estimated that such a program could yield more than 400 TAF annually.

New Off-Stream Storage— A moderately sized off-stream storage facility (±500 TAF) would be developed to increase the management flexibility of Delta exports. This reservoir would be located on the west side of the San Joaquin Valley and linked to the

state and federal conveyance facilities. The reservoir would serve to store Delta diversions made during favorable periods and reregulate those diversions at needed to meet demands south of the Delta or to reduce Delta diversions during environmentally sensitive periods.

In-Lieu Groundwater Banking— To provide additional insurance for drought conditions and to improve the current over-draft conditions in the San Joaquin and Tulare basins an in-lieu groundwater banking program will be developed. Under this program surface water will be supplied to agricultural users currently dependant on groundwater in areas overlying over-drafted groundwater basins. The volume of groundwater replaced with surface water would be credited to the transfer program and be utilized primarily during drought periods through substitution or direct export.

Conservation— Improve implementation of urban Best Management Practices (BMPs) and add BMPs requiring inclining block rates to encourage reduced landscape water use. Implement agricultural Efficient Water Management Practices (EWMPs) that include installation of measurement devices and water pricing and incentives designed to optimize management and efficiency. Conservation practices would be implemented in all areas of the state.

Reclamation— Implement reclamation and reuse projects for urban and agricultural supplies were feasible. Projects would be developed to increase the use of grey water for urban landscape irrigation, particularly in areas of new development. Develop local reclamation projects to supply agricultural users with reclaimed water. This alternative would also investigate more efficient and cost effective water reclamation processes.

Land Retirement and Fallowing— Maximize the retirement of marginal agricultural lands. This program would emphasize the purchase of lands that contribute to regional drainage and discharge problems.

Adaptive Management Program for Supplemental Transfers— The supplemental water transfer program will be coordinated and monitored by a central body to ensure its efficient use and effective long-term management. The program will coordinate timing of water transfers to coincide with in-stream fishery needs both upstream and within the Delta and export capacity at project facilities. The program will also act as a broker to match available transfer supplies with demands. To ease the implementation of water transfers for this program a programmatic environmental impact statement (PEIS) would be prepared to define criteria for transferring water through the Delta. The PEIS would also identify appropriate and streamlined refill impact criteria for both surface and groundwater sources.

Levee Improvements— Provide land side buffer zones to minimize and reduce Delta island subsidence. Also improve habitat levee maintenance and stabilization to at least hazard mitigation plan standards (HMP; a level of protection less than the 100-year flood) for all islands containing existing infrastructure. Levee protection on selected western

Delta islands will be improved to the National Flood Insurance Program standards (NFIP; 100-year flood protection). The exact level of levee improvements will be tempered by economic feasibility and need. In some instance the cost of levee protection may out way the benefits or cost of infrastructure relocation.

Supporting Actions

Migration Barriers— Install fish migration barriers at Georgiana Slough and the Delta Cross Channel to reduce fish entrainment in the interior Delta. Migration barriers, acoustic or otherwise, will allow the Delta Cross Channel to remian open a for a greater period of time to increase flows to the south Delta to improve the availability and flexibility of Delta export to export water.

Reduce Fish Entrainment and Losses at CVP and SWP Facilities— Reduce entrainment and mortality of fish salvaged at Banks and Tracy pumping plants. Measures to reduce entrainment and losses should include:

- Increase diversion screen efficiencies.
- Improve fish salvage and handling.
- Monitor entrainment on a real time basis to identify periods of peak susceptibility of various species.
- Improve predator control at both facilities.
- Coordinate operations of two diversions, including interchangeable pumping, to reduce combined losses.

Hatchery Management—Improve hatchery production for various fish species that use the Bay-Delta Estuary. Improved hatchery production and coordination would serve to: mitigate the loss of stream spawning and rearing habitat; mitigate increasing harvest pressures; and provide short term support for various species until other programs to improve fish survival and habitat conditions are implemented.

Delta Adaptive Management Programs— Develop adaptive management programs for efficient operations of the Delta Cross Channel, migration barriers, export and Delta outflows, fish salvage operations and hatchery programs. An adaptive management program should consider the appointment of a Delta water master to oversee the effective management of Delta programs related to movement of water for export, local diversion, and environmental needs. To ensure genetic diversity hatchery production should be practiced to compliment, not replace, measures to improve the natural production and survival of fish species.

Delta Habitat Restoration— Develop an intensive program of habitat restoration that would improve the availability of riverine, riparian, wetland, and terrestrial habitat within the Delta. These habitat improvements would be focused on increasing the natural productivity and survival of species that rely on the Bay-Delta Estuary.

Preliminary Assessment

Ecosystem Quality— Core habitat restoration actions would be implemented near the maximum levels within the Bay-Delta Estuary and on the Sacramento and San Joaquin Rivers. The habitat measures undertaken as part of this alternative would improve habitat availability and quality. Because this alternative is focused on retaining the south Delta export facilities and increasing the volumes of water exported from Delta, habitat and ecosystem restoration measures in the Delta would be focused on reducing the impacts of diversions and reverse flows associated with Delta exports.

Water Supply— This alternative would rely on both reducing demand and increasing the supply availability. The results of demand management will reduce the growth of demand in the export area and increase the available supply in the area upstream of the Delta. Along with developing water transfers these two action will ensure continued management of demands and supplies. Off-stream storage and in-lieu groundwater banking will be operated to store excess water as groundwater for insurance against drought deficiencies.

Water Quality— Water quality will be improved through implementation of core actions and through the retirement of marginal lands which contribute to drainage problems. Key actions implemented to the maximum levels feasible will be to control agricultural drainage. Changes in agricultural drain management to reduce the overall pollutant loads of the system will be preferred, including modifications to agricultural practices to reduce the discharge of pollutants.

System Reliability— System vulnerability is improved in this alternative, above the current levels. Because this alternative continues to rely on water exports in the south Delta, the level of levee protection will be increased to an appropriate level to reduce the risk of catastrophic failures that would interrupt supply availability.

Ecosystem

B-004653

Alternative EQ-1

Group
Ecosystem Quality

Title
Reduce Diversion Effects and Habitat Creation
Small Transfer Facility and Water Purchase/Exchange

This alternative focuses on increasing populations of anadramous and Bay-Delta native fish through a moderate level of habitat improvements, by reducing the impact of the south-Delta pumps on fisheris by providing a percentage of export water from new upsteam diversions, and by makeing water purchases and exchanges to help move fish past the pumps in the south-Delta. New storage in the upper Sacramento valley will be developed to increase the water supply reliability and water quality. Levee improvements will be made in ways that reduce system vulnerability while improving ecosystem quality. Source control of pollutants and reclamation will increase water quality for all benefical uses.

Habitat improvements will be made throughout the watershed to improve ecosystem quality and aid the recovery of species of special concern. In-Delta levee water side and land side modifications to provide shallow water habitat and riparian habitat will be made at many sites. Dredge material will be used to recreate new shallow water habitat and Delta island habitat. Habitat improvements will also be made upstream and downstream of the Delta, including riparian habitat on the Sacramento River, channel improvements on the San Joaquin River, and conversion of diked wetlands to tidal wetlands between Collinsville and Carquinez Strait. Water supply reliability and Delta species will both benefit from new storage and modified water operations. About 100,000 acre feet will be purchased from sources on the San Joaquin River system to benefit fish. Uses might include pulses to aid fish movement, dilution of poor quality San Joaquin River flows, or exchange with export customers at critical times so Delta exports could be curtailed. Operation of Clifton Court Forebay will be modified to reduce intake of fish.

A small percentage of flood flows in the Sacramento and Feather Rivers will be captured in new upstream storage and released at critical times for west Sacramento valley agriculture and for Delta supply. This will allow changes in present diversion patterns to increase at times of lessor environmental sensitivity, such as winters of above normal and wet years. Diversions will be via pumps at the Red Bluff diversion dam and conveyed via the Tehama-Colusa Canal to a new off-stream reservoir. Diversions by gravity form the Thermalito afterbay will be conveyed by new facility to the off- stream reservoir.

A small, west-side transfer facility connected to the new reservoir will convey releases form the new reservoir to the pumps in the south-Delta with possible undertows with the North Bay Aqueduct, Contra Costa Canal and the South Bay aqueduct. Delta water quality will be improved through point and nonpoint source control and agricultural, industrial, and municipal wastewater reclamation and reuse, and timing and dilution of releases of poor quality agricultural drainage. The vulnerability of Delta land use, Delta water supply, agricultural export water supply and Delta ecosystem function to catastrophic failure is reduced by improving levees on critical western islands, and elsewhere within the Delta.

Physical and Structural Actions

Delta Levee Habitat Restoration— Restore approximately 100 levee miles of shallow water, riverine and riparian habitat in the Delta to provide forage and cover habitat for resident and anadromous fish, and to provide other benefits associated with riparian habitat. Actions might include setback levees, creation of berms, creation of shallow water habitat, and increased vegetation on levees. Considerations for site selection will include distance from hazards such as pumping plants, protection from waves generated by wind and boat wakes, importance of island integrity to the maintenance of Delta water quality, and need to improve channel capacity and structural stability of levees. Good candidate areas are Twitchell Island along Three Mile Slough and Seven Mile Slough, Georgiana Slough, and the north and south forks of the Mokelumne River.

Delta Habitat Restoration— Restore shallow water and tidal wetland habitat in the Delta to provide spawning areas, forage areas, and escape cover for juvenile salmon, Delta smelt, splittail, and other species. Candidate areas include Prospect Island, Liberty Island, Little Holland Tract, Decker Island, Hastings Tract, Yolo Bypass, and the southeast Delta. Also restore shallow water shoreline habitat along margins of the lower Sacramento and San Joaquin channels, and tributary sloughs including Georgiana Slough, Barker Slough, Lindsey Slough, and Parker Island. Riparian, wetland, and terrestrial habitat would also be restored on Delta islands and upland areas adjacent to river channels.

San Joaquin River Habitat Restoration— Restore channel features to improve fish survival. Actions may include restoration of deeper, narrower channel areas to keep water cooler, and isolation of quarry areas to protect young fish from predation and straying.

Bay Habitat Restoration— Restore about 2,000 acres of tidal wetlands between Collinsville and Carquinez Strait. Actions may include conversion of diked wetlands to tidal wetlands or use of dredge spoils to create wetland areas. The resulting habitat types will provide wet year spawning habitat for Delta smelt, rearing areas for salmon, as well as habitat for diverse wildlife including canvasback and redhead ducks.

Channel Islands—Restore and protect channel islands. Evaluate contribution of upstream meander belts to sediment deposition at channel islands. Establish zones for different types of boating use so some areas are protected from large boat wakes.

Install Bypass at Mouth of Old River—Construct a bypass at the mouth of Old River that will encourage out migrants to stay in San Joaquin River while allowing a managed flow down Old River.

Fish Screens—Install fish screens on diversions over 250 cfs that are on fish migration routes in the Delta, rivers, and tributaries.

New diversions—Construct a new diversion at Thermalito afterbay with a capacity to capture significant wet weather flows that would other wise must be released. (2,000 to 7,000cfs).

Develop additional off-stream storage—Develop approximately 2 million ac-ft of new storage capacity at off-stream reservoir site(s) that can be fed by the Tahama Colusa Canal, such as the Colusa-Sites reservoir. Operate the reservoir to supply westside Sacramento Valley agricultural irrigation water, and exports from the Delta for agriculture, M&I, and the Sacramento River and tributaries environmental uses.

Develop conveyance facilities—Develop conveyance facilities to connect the diversions to the west-side storage facility. From the storage facility connect to the Tehama-Colusa Canal, Glenn-Colusa Irrigation District, possibly the North Bay Aqueduct, and a cross-Delta Transfer facility. Provide turnouts to streamflow augmentation points and to groundwater conjunctive use areas on the west and east sides of the valley.

Construct an isolated west-side cross-Delta Facility—Construct an isolated conveyance system that connects the west-side storage project to the California Aqueduct and/or the Delta Mendota Canal. The capacity of the facility would approximately equal the present capacity of the Delta Mendota Canal. (Around 5,000 to 10,000 cfs)

Other Programs—Implement recommended habitat restoration actions from other programs, including CVPIA and the Anadromous Fish Restoration Plan. Examples of specific actions include small dam removal on Clear Creek, dam removal on Battle Creek, establishment of a population of winter run chinook salmon on Battle Creek.

Sacramento River Habitat Restoration—Provide for USCE matching funds to conduct a feasibility study for habitat restoration on the Sacramento River from Sacramento to Collinsville. Study is a 50/50 cost share. The construction is 75 percent USCE match. Feasibility study will take 2 years and cost around $2M. Make restoration non-homogenous and allow for recreation sites.

Levee Upgrades—Provide landside buffer zones of 50 to 75 yards to minimize levee subsidence for islands providing valuable existing habitat, such as on Bradford Island. Improve levee maintenance and stabilization to at least National Flood Insurance Program standards (NFIP; 100-year flood protection) for all islands, such as Tyler and Mandeville, containing existing infrastructure and/or land use that provides economic benefit to the region. Improve levee maintenance and stabilization to at least Bulletin 192-82 or PL-99 standards (generally considerably more than 100-year flood protection) for critical western Delta islands, such as Brannan-Andrus, Bethel, and Sherman, to reduce risk to critical infrastructure (e.g. Mokelumne Aqueduct, PG&E gas lines, Highway 160) and to reduce risk to export water quality from salinity intrusion due to levee failure. A levee management plan would provide necessary funding for ongoing maintenance and emergency funding and direction to reclaim Delta islands in the event of inundation in order to continue protection of Delta functions as an integrated resource system.

Management and Operation

Obtain environmental water—Obtain around 100,000 acre feet from San Joaquin water users to be used for fisheries benefits. Uses might include pulses to aid fish movement, dilution of poor quality San Joaquin River flows, or exchange with export customers at critical times so Delta exports could be curtailed. South of Delta storage for environmental exchange water

Real time monitoring—Establish an adequate real-time monitoring to determine location of species of special concern so that project operations can be effectively managed to reduce losses of fish and minimize effects on habitat.

Acoustic Barrier at Mouth of Georgiana Slough—Operate an acoustic barrier at the mouth of Georgiana Slough. Work to improve the effectiveness of behavioral barriers. Evaluate use of acoustic barriers at the Delta Cross Channel and 3-Mile Slough.

Storage of Agricultural Tile Drain Water—Develop a program with irrigation districts to store tile drain water to be released at times when pulse flows can provide dilution.

Modify Clifton Court Forebay Operation—Modify operations of Clifton Court Forebay so that it does not entrain as many fish into the forebay during typical "Big Gulp" operation. Install regulating gates into Italian Slough so that water can be drawn in over time at a lower velocity. This will reduce the number of fish lost to predation in the forebay.

Project Operations—Change reservoir operations to seasonally modify the timing of Delta inflows to increase flows during environmentally sensitive periods such as late spring and early fall.

Encourage groundwater banking and conjunctive use—In order to maximize the opportunity for groundwater reclamation and recharge, and conjunctive use with the west-side surface storage, encourage and provide the conveyance facilities to aquifers such as the Butte Creek and Stoney Creek Basins.

Mark Hatchery Fish — Mark salmon produced in hatcheries to facilitate selective catch by commercial and recreation fisheries.

Pen Rearing of Striped Bass — Rear striped bass in pens to maintain recreational fishery and avoid operational constraints on water projects due to spawning bass.

Response Program for Exotic Species Control— Establish and fund a rapid response program among environmental agencies to provide a fast and effective means of managing exotic species introduced to the Bay-Delta. Carry out continuing management programs for nuisance species such as water hyacinth.

Reclamation—Reclaim agricultural, municipal, and industrial wastewater for a variety of uses, improving water quality by reducing wastewater discharges.

Mine Drainage Remediation—Remediate discharges from abandoned mines in tributaries of the upper Sacramento River downstream of Shasta Dam to the maximum extent reasonably possible.

Management of Water Quality—Implement actions such as source control regulations for agricultural drainage, retiring lands with drainage problems, and other cost-effective management of urban, agricultural, and industrial discharges and runoff to improve Delta water quality.

Institutional and Policy

Water Quality Standards — Maintain current standards for Delta water quality and position of X2.

Preserve Agricultural Land Uses— Establish programs to preserve agricultural land uses that help to protect the ecosystem. Examples include limiting levee restoration to levels that are inadequate to permit residential construction on Delta islands, and incentive programs to preserve habitats such as pasture, which is important for sandhill cranes.

CALFED Regulatory Team—Determine how to implement a regulatory team to facilitate getting permits for environmental restoration projects. Each member agency would have a key person on team.

Dredge Materials—Establish a policy that all future clean dredge material out of the Delta above Chipps Island should go into Delta restoration projects.

Safe Harbor for Maintenance— Encourage farmers and levee maintenance districts to leave habitat areas undisturbed when feasible by providing protection from ESA provisions.

Preliminary Assessment

Ecosystem Quality—This alternative will moderately enhance ecosystem quality through restoration and enhancement of riverine, riparian, wetland, and adjacent terrestrial habitat. Expansion of floodway habitat, channels, and meander belts in the Bay-Delta will help to restore fish spawning, rearing, and feeding habitats and improve fish survival. Improvements to Clifton Court Forebay will also help in reducing the numbers of fish diverted into the forebay and increasing survival of fish that are drawn into the forebay. Though improvements to habitat and fish survival will occur, complete restoration of important fish populations may not be possible without reducing the use of the Delta as a water supply conduit and greatly reducing exports from the south Delta. Moving a major portion of the south Delta diversions to screened locations upstream of the Delta will also reduce impacts on fisheries.

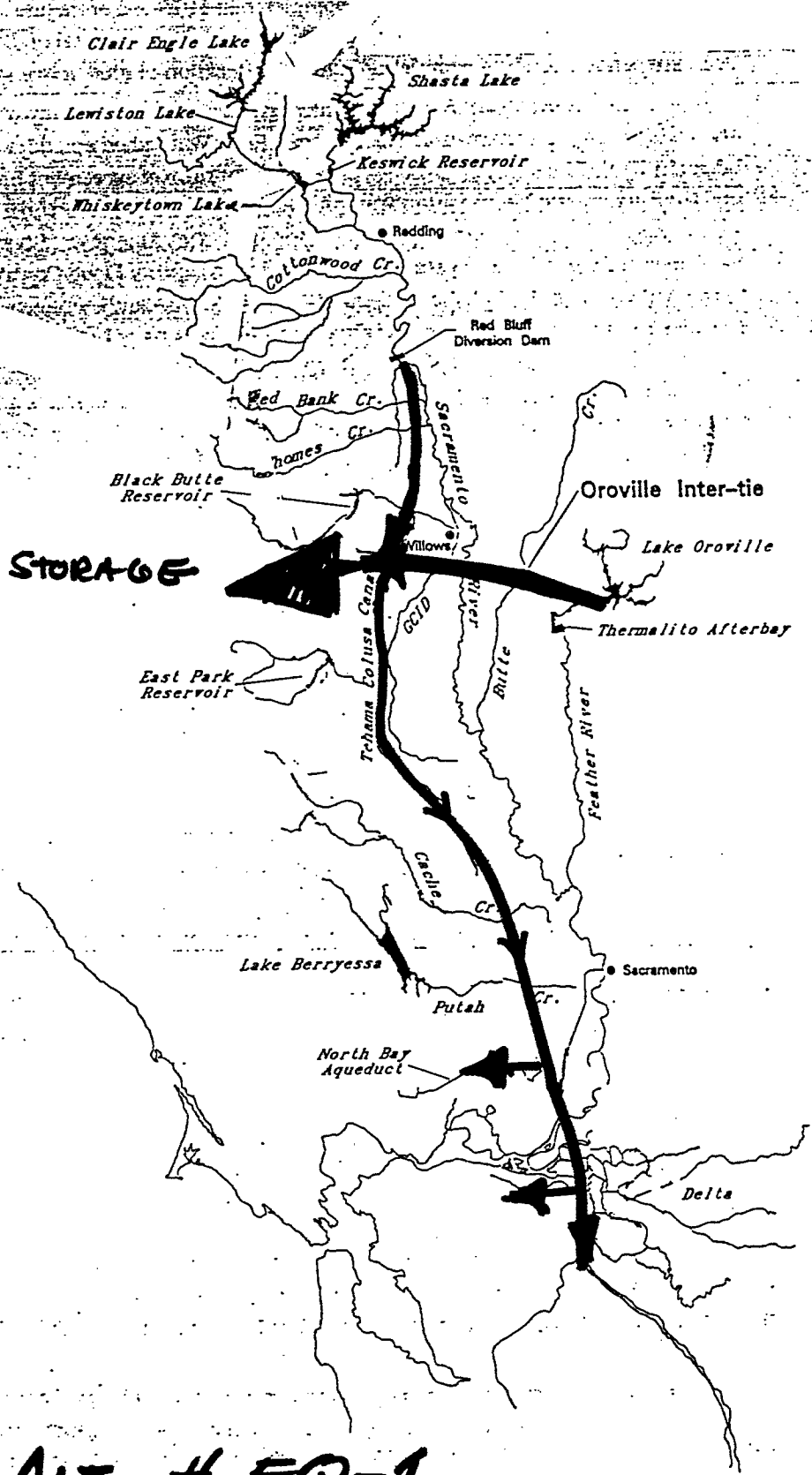
Water Supply—This alternative improves M&I water supply and reliability through development of additional upstream storage and operation of the west-side transfer facility. By relocating M&I diversions outside the Delta, the full capacity of the existing export pumps would be available for agricultural diversions, increasing the supply and availability of water to agricultural exporters.

Water Quality—This alternative improves M&I export water quality by relocating the diversion upstream of the Delta. Delta water quality is improved through reclamation of agricultural, municipal, and industrial wastewater. Other water quality improvements are achieved by point and non-point source controls and mine drainage Remediation to improve water quality.

System Vulnerability—Relocating M&I export facilities outside of the Delta essentially eliminates the risk that operations will be interrupted by a failure of in-Delta facilities. Creation of shallow water habitat simultaneously provides better levees and protection for adjacent land uses. Improvement of the levees around the critical western islands protects those islands as well as protecting in-Delta and agricultural export water supplies from salinity intrusion due to island

failure. Other key, supporting and core actions improve the reliability of in-Delta facilities through levee management, and levee reconstruction.

B-004659



ALT # EQ-1

B—004660

B-004660

Alternative EQ-2

Group
Ecosystem Quality

Title
Maximum Habitat Restoration

This alternative emphasizes extensive habitat restoration to improve ecosystem health and increase populations of special status species. Healthy populations of these species, including Delta smelt and winter-run chinook salmon, will be better able to withstand the impacts of Delta water export operations. New water storage in the Delta will be managed to benefit ecosystem health and water supply reliability. Restoration of leveed lands to tidal shallow water habitat would provide new habitat for native fish species. Levee improvements will be made in ways that reduce system vulnerability while restoring nearshore aquatic habitat, as well as riparian vegetation. Long-term programs to manage subsidence will also reduce vulnerability. Source control of pollutants will increase water quality for all beneficial uses.

Habitat improvements will be made throughout the watershed to improve ecosystem quality and aid the recovery of species of special concern. In-Delta levee water side and land side modifications to provide shallow water habitat and riparian habitat will be made at many sites. Dredge material will be used to recreate new shallow water habitat out of deeper Delta island habitat. A long-term program to manage subsidence will be implemented. Habitat improvements will also be made upstream and downstream of the Delta, including riparian habitat and meander belts on the Sacramento River, channel improvements on the San Joaquin River, and conversion of diked wetlands to tidal wetlands between Collinsville and Carquinez Strait. Water supply reliability and Delta species will both benefit from new storage and modified water operations. About 100,000 acre feet will be purchased from sources on the San Joaquin River system to benefit fish. Uses might include pulses to aid fish movement, dilution of poor quality San Joaquin River flows, or exchange with export customers at critical times so Delta exports could be curtailed. South of Delta storage for environmental exchange water might need to be developed. This could allow for flexibility of exchange with San Joaquin users. An in-Delta reservoir will be developed (up to 200,000 to 300,000 acre feet) to be used to create additional storage and provide water to the export pumps at critical fish migration times. Operation of Clifton Court Forebay will be modified to reduce intake of fish. Delta water quality will be improved through agricultural, industrial, and municipal wastewater reclamation and reuse, timing and dilution of releases of poor quality agricultural drainage, and better source control.

Physical and Structural Actions

Delta Levee Habitat Restoration— Restore approximately 100 levee miles of shallow water, riverine and riparian habitat in the Delta to provide forage and cover habitat for resident and anadromous fish, and to provide other benefits associated with riparian habitat. Actions might include setback levees, creation of berms, creation of shallow water habitat, and increased vegetation on levees. Considerations for site selection will include distance from hazards such as pumping plants, protection from waves generated by wind and boat wakes, importance of island integrity to the maintenance of Delta water quality, and need to improve channel capacity and structural stability of levees. Good candidate areas are Twitchell Island along Three Mile Slough and Seven Mile Slough, Georgiana Slough, and the north and south forks of the Mokelumne River.

Delta Habitat Restoration— Restore shallow water and tidal wetland habitat in the Delta to provide spawning areas, forage areas, and escape cover for juvenile salmon, Delta smelt, splittail, and other species. Candidate areas include Prospect Island, Liberty Island, Little Holland Tract, Decker Island, Hastings Tract, Yolo Bypass, and the southeast Delta. Also restore shallow water shoreline habitat along margins of the lower Sacramento and San Joaquin channels, and tributary sloughs including Georgianna Slough, Barker Slough, Lindsey Slough, and Parker Island. Riparian, wetland, and terrestrial habitat would also be restored on Delta islands and upland areas adjacent to river channels.

Sacramento River Habitat Restoration—Restore habitat and geomorphic processes along the Sacramento River upstream of the Delta to increase survival and spawning success of anadromous fish, and to provide other benefits. Construct segments of meander belt where feasible (such as Red Bluff to Colusa) and restore segments of riparian habitat in more controlled stretches of the river (Colusa to Knights Landing.)

San Joaquin River Habitat Restoration— Restore channel features to improve fish survival. Actions may include restoration of deeper, narrower channel areas to keep water cooler, and isolation of quarry areas to protect young fish from predation and straying.

Bay Habitat Restoration— Restore about 5,000 acres of tidal wetlands between Collinsville and Carquinez Strait. Actions may include conversion of diked wetlands to tidal wetlands or use of dredge spoils to create wetland areas. The resulting habitat types will provide wet year spawning habitat for Delta smelt, rearing areas for salmon, as well as habitat for diverse wildlife including canvasback and redhead ducks.

Channel Islands—Restore and protect channel islands. Evaluate contribution of upstream meander belts to sediment deposition at channel islands. Establish zones for different types of boating use so some areas are protected from large boat wakes.

In-Delta Storage close to the Pumps—Convert one or more Delta islands such as Bacon Island, Mandeville Island, or Victoria Island into a reservoir to provide operational flexibility and generate up to 300,000 acre feet of storage. The levee around the storage reservoir will be up to several hundred feet wide to support riparian forest cover and provide opportunities for creation of pockets of shallow water habitat. The shallow inward slopes of the levees might support water grass habitat for migratory waterfowl, depending on reservoir operation. The reservoir might be suitable for Sacramento perch habitat. Water will be diverted onto islands through screened diversions during the months of November, December or January depending on the type of water year. Water will be released from March to July to provide water to the pumps at times when project operations would otherwise draw fish into the Delta or to the pumps. Water may also be used to provide other fisheries benefits.

Install Bypass at Mouth of Old River—Construct a bypass at the mouth of Old River that will encourage outmigrants to stay in San Joaquin River while allowing a managed flow down Old River.

Fish Screens—Install fish screens on diversions over 100 cfs that are on fish migration routes in the Delta, rivers, and tributaries.

Other Programs—Implement recommended habitat restoration actions from other programs, including CVPIA and the Anadromous Fish Restoration Plan. Examples of specific actions include small dam removal on Clear Creek, dam removal on Battle Creek, establishment of a population of winter run chinook salmon on Battle Creek.

Sacramento River Habitat Restoration—Provide for USCE matching funds to conduct a feasibility study for habitat restoration on the Sacramento River from Sacramento to Collinsville. Study is a 50/50 cost share. The construction is 75 percent USCE match. Feasibility study will take 2 years and cost around $2M. Make restoration non-homogenous and allow for recreation sites.

Management and Operation

Obtain environmental water—Obtain approximately 100,000 acre feet from San Joaquin water users to be used for fisheries benefits. Uses might include pulses to aid fish movement, dilution of poor quality San Joaquin River flows, or exchange with export customers at critical times so Delta exports could be curtailed. South of Delta storage for environmental exchange water might need to be developed. This would allow for flexibility of exchange with San Joaquin users.

Real time monitoring—Establish an adequate real-time monitoring to determine location of species of special concern so that project operations can be effectively managed to reduce losses of fish and minimize effects on habitat.

Acoustic Barrier at Mouth of Georgiana Slough—Operate an acoustic barrier at the mouth of Georgiana Slough. Work to improve the effectiveness of behavioral barriers. Evaluate use of acoustic barriers at the Delta Cross Channel and 3-Mile Slough.

Storage of Agricultural Tile Drain Water—Develop a program with irrigation districts to store tile drain water to be released at times when pulse flows can provide dilution.

Modify Clifton Court Forebay Operation—Modify operations of Clifton Court Forebay so that it does not entrain as many fish into the forebay during typical "Big Gulp" operation. Install regulating gates into Italian Slough so that water can be drawn in over time at a lower velocity. This will reduce the number of fish lost to predation in the forebay.

Implement a Subsidence Management Program— Develop and implement a very long-term subsidence management program that prescribes land use strategies related to the degree of subsidence. For some deep Delta islands (below -10 feet in elevation) eliminate traditional agriculture in favor of seasonal wetland management to stop and reverse subsidence. At elevations from -10 to -3 feet, stabilize subsidence by rotating seasonal wetland with wildlife-friendly agricultural use. At elevations from -3 to +3 feet, maintain agricultural uses on some parcels, identify other areas for restoration to tidal wetlands.

Mark Hatchery Fish — Mark salmon produced in hatcheries to facilitate selective catch by commercial and recreation fisheries.

Pen Rearing of Striped Bass — Rear striped bass in pens to maintain recreational fishery and avoid operational constraints on water projects due to spawning bass.

Response Program for Exotic Species Control— Establish and fund a rapid response program among environmental agencies to provide a fast and effective means of managing exotic species introduced to the Bay-Delta. Carry out continuing management programs for nuisance species such as water hyacinth.

Mine Drainage Remediation—Remediate discharges from abandoned mines in tributaries of the upper Sacramento River downstream of Shasta Dam to the maximum extent reasonably possible.

Management of Water Quality—Implement actions such as source control regulations for agricultural drainage, retiring lands with drainage problems, and other cost-effective management of urban, agricultural, and industrial discharges and runoff to improve Delta water quality.

Institutional and Policy

Water Quality Standards — Maintain current standards for Delta water quality and position of X2.

Preserve Agricultural Land Uses— Establish programs to preserve agricultural land uses that help to protect the ecosystem. Examples include limiting levee restoration to levels that are inadequate to permit residential construction on Delta islands, and incentive programs to preserve habitats such as pasture, which is important for sandhill cranes.

CALFED Regulatory Team—Determine how to implement a regulatory team to facilitate getting permits for environmental restoration projects. Each member agency would have a key person on team.

Dredge Materials—Establish a policy that all future clean dredge material out of the Delta above Chipps Island should go into Delta restoration projects.

Safe Harbor for Maintenance— Encourage farmers and levee maintenance districts to leave habitat areas undisturbed when feasible by providing protection from ESA provisions.

Preliminary Assessment

Ecosystem Quality—This alternative will greatly enhance ecosystem quality through restoration and enhancement of riverine, riparian, wetland, and adjacent terrestrial habitat. Expansion of floodway habitat, channels, and meander belts in the Bay-Delta and upstream in rivers and tributaries will help to restore fish spawning, rearing, and feeding habitats and improve fish survival. Purchased fish water from the San Joaquin will greatly enhance the fisheries agencies'

ability to assist fish passage from the rivers through the Delta. The in-delta storage will add flexibility for exchange with export water to reduce the cross Delta movement of fish toward south Delta pumping plants. Improvements to Clifton Court Forebay will also help in reducing the numbers of fish diverted into the forebay and increasing survival of fish that are drawn into the forebay. Though great improvements to habitat and fish survival wll occur, complete restoration of important fish populations may not be possible without reducing the use of the Delta as a water supply conduit and greatly reducing exports from the south Delta.

Water Supply—This alternative improves the reliability of water supply by providing for the release of south Delta storage during key seasons, by increasing fish populations (through habitat improvements and reduce diversion effects), and by using stored and exchanged water to help avoid interruptions in pumping.

Water Quality—This alternative relies on core actions including point and non-point source controls and mine drainage remediation to improve water quality.

System Vulnerability—Creation of shallow water habitat simultaneously with levee reconstruction provides better levees and protection for adjacent land uses. Improvement of the levees around the critical western islands protects those islands as well as protecting in-Delta and agricultural export water supplies from salinity intrusion due to island failure.

Alternative EQ-3

Group
Ecosystem Quality

Title
Moderate Habitat Restoration

This alternative emphasizes moderate habitat restoration to improve ecosystem health and increase populations of special status species. Healthy populations of these species, including Delta smelt and winter-run chinook salmon, will be better able to withstand the impacts of Delta water export operations. Restoration of leveed lands to tidal shallow water habitat would provide new habitat for native fish species. Levee improvements will be made in ways that reduce system vulnerability while restoring nearshore aquatic habitat, as well as riparian vegetation. Long-term programs to manage subsidence will also reduce vulnerability. Source control of pollutants will increase water quality for all beneficial uses.

Habitat improvements will be made throughout the watershed to improve ecosystem quality and aid the recovery of species of special concern. In-Delta levee water side and land side modifications to provide shallow water habitat and riparian habitat will be made at many sites. Dredge material will be used to recreate new shallow water habitat out of deeper Delta island habitat. A long-term program to manage subsidence will be implemented. Habitat improvements will also be made upstream and downstream of the Delta, including riparian habitat and channel improvements on the San Joaquin River, and conversion of diked wetlands to tidal wetlands between Collinsville and Carquinez Strait. Water supply reliability and Delta species will both benefit from habitat improvements and levee protection. Operation of Clifton Court Forebay will be modified to reduce intake of fish. Delta water quality will be improved through agricultural, industrial, and municipal wastewater reclamation and reuse, timing and dilution of releases of poor quality agricultural drainage, and better source control.

Physical and Structural Actions

Delta Levee Habitat Restoration— Restore approximately 100 levee miles of shallow water, riverine and riparian habitat in the Delta to provide forage and cover habitat for resident and anadromous fish, and to provide other benefits associated with riparian habitat. Actions might include setback levees, creation of berms, creation of shallow water habitat, and increased vegetation on levees. Considerations for site selection will include distance from hazards such as pumping plants, protection from waves generated by wind and boat wakes, importance of island integrity to the maintenance of Delta water quality, and need to improve channel capacity and structural stability of levees. Good candidate areas are Twitchell Island along Three Mile Slough and Seven Mile Slough, Georgiana Slough, and the north and south forks of the Mokelumne River.

Delta Habitat Restoration— Restore shallow water and tidal wetland habitat in the Delta to provide spawning areas, forage areas, and escape cover for juvenile salmon, Delta smelt, splittail, and other species. Candidate areas include Prospect Island, Liberty Island, Little Holland Tract, Decker Island, Hastings Tract, Yolo Bypass, and the southeast Delta. Also restore shallow water shoreline habitat along margins of the lower Sacramento and San Joaquin channels, and tributary sloughs including Georgianna Slough, Barker Slough, Lindsey Slough, and Parker Island.

Riparian, wetland, and terrestrial habitat would also be restored on Delta islands and upland areas adjacent to river channels.

San Joaquin River Habitat Restoration— Restore channel features to improve fish survival. Actions may include restoration of deeper, narrower channel areas to keep water cooler, and isolation of quarry areas to protect young fish from predation and straying.

Bay Habitat Restoration— Restore about 2,000 acres of tidal wetlands between Collinsville and Carquinez Strait. Actions may include conversion of diked wetlands to tidal wetlands or use of dredge spoils to create wetland areas. The resulting habitat types will provide wet year spawning habitat for Delta smelt, rearing areas for salmon, as well as habitat for diverse wildlife including canvasback and redhead ducks.

Channel Islands—Restore and protect channel islands. Evaluate contribution of upstream meander belts to sediment deposition at channel islands. Establish zones for different types of boating use so some areas are protected from large boat wakes.

Install Bypass at Mouth of Old River—Construct a bypass at the mouth of Old River that will encourage outmigrants to stay in San Joaquin River while allowing a managed flow down Old River.

Fish Screens—Install fish screens on diversions over 250 cfs that are on fish migration routes in the Delta, rivers, and tributaries.

Other Programs—Implement recommended habitat restoration actions from other programs, including CVPIA and the Anadromous Fish Restoration Plan. Examples of specific actions include small dam removal on Clear Creek, dam removal on Battle Creek, establishment of a population of winter run chinook salmon on Battle Creek.

Sacramento River Habitat Restoration—Provide for USCE matching funds to conduct a feasibility study for habitat restoration on the Sacramento River from Sacramento to Collinsville. Study is a 50/50 cost share. The construction is 75 percent USCE match. Feasibility study will take 2 years and cost around $2M. Make restoration non-homogenous and allow for recreation sites.

Management and Operation

Real time monitoring—Establish an adequate real-time monitoring to determine location of species of special concern so that project operations can be effectively managed to reduce losses of fish and minimize effects on habitat.

Acoustic Barrier at Mouth of Georgiana Slough—Operate an acoustic barrier at the mouth of Georgiana Slough. Work to improve the effectiveness of behavioral barriers. Evaluate use of acoustic barriers at the Delta Cross Channel and 3-Mile Slough.

Storage of Agricultural Tile Drain Water—Develop a program with irrigation districts to store tile drain water to be released at times when pulse flows can provide dilution.

Modify Clifton Court Forebay Operation—Modify operations of Clifton Court Forebay so that it does not entrain as many fish into the forebay during typical "Big Gulp" operation. Install regulating gates into Italian Slough so that water can be drawn in over time at a lower velocity. This will reduce the number of fish lost to predation in the forebay.

Implement a Subsidence Management Program— Develop and implement a very long-term subsidence management program that prescribes land use strategies related to the degree of subsidence. For some deep Delta islands (below -10 feet in elevation) eliminate traditional agriculture in favor of seasonal wetland management to stop and reverse subsidence. At elevations from -10 to -3 feet, stabilize subsidence by rotating seasonal wetland with wildlife-friendly agricultural use. At elevations from -3 to +3 feet, maintain agricultural uses on some parcels, identify other areas for restoration to tidal wetlands.

Mark Hatchery Fish — Mark salmon produced in hatcheries to facilitate selective catch by commercial and recreation fisheries.

Pen Rearing of Striped Bass — Rear striped bass in pens to maintain recreational fishery and avoid operational constraints on water projects due to spawning bass.

Response Program for Exotic Species Control— Establish and fund a rapid response program among environmental agencies to provide a fast and effective means of managing exotic species introduced to the Bay-Delta. Carry out continuing management programs for nuisance species such as water hyacinth.

Mine Drainage Remediation—Remediate discharges from abandoned mines in tributaries of the upper Sacramento River downstream of Shasta Dam to the maximum extent reasonably possible.

Management of Water Quality—Implement actions such as source control regulations for agricultural drainage, retiring lands with drainage problems, and other cost-effective management of urban, agricultural, and industrial discharges and runoff to improve Delta water quality.

Institutional and Policy

Water Quality Standards — Maintain current standards for Delta water quality and position of X2.

Preserve Agricultural Land Uses— Establish programs to preserve agricultural land uses that help to protect the ecosystem. Examples include limiting levee restoration to levels that are inadequate to permit residential construction on Delta islands, and incentive programs to preserve habitats such as pasture, which is important for sandhill cranes.

CALFED Regulatory Team—Determine how to implement a regulatory team to facilitate getting permits for environmental restoration projects. Each member agency would have a key person on team.

Dredge Materials—Establish a policy that all future clean dredge material out of the Delta above Chipps Island should go into Delta restoration projects.

Safe Harbor for Maintenance— Encourage farmers and levee maintenance districts to leave habitat areas undisturbed when feasible by providing protection from ESA provisions.

Preliminary Assessment

Ecosystem Quality—This alternative will moderately enhance ecosystem quality through restoration and enhancement of riverine, riparian, wetland, and adjacent terrestrial habitat. Expansion of floodway habitat, channels, and meander belts in the Bay-Deltawill help to restore fish spawning, rearing, and feeding habitats and improve fish survival. Improvements to Clifton Court Forebay will also help in reducing the numbers of fish diverted into the forebay and increasing survival of fish that are drawn into the forebay. Though improvements to habitat and fish survival wll occur, complete restoration of important fish populations may not be possible without reducing the use of the Delta as a water supply conduit and greatly reducing exports from the south Delta.

Water Supply—This alternative provides limited improvement to the reliability of water supply by increasing fish populations (through habitat improvements and reduce diversion effects).

Water Quality—This alternative relies on core actions including point and non-point source controls and mine drainage remediation to improve water quality.

System Vulnerability—Creation of shallow water habitat simultaneously with levee reconstruction provides better levees and protection for adjacent land uses. Improvement of the levees around the critical western islands protects those islands as well as protecting in-Delta and agricultural export water supplies from salinity intrusion due to island failure.

Alternative EQ-4

Group
Ecosystem Quality

Title
Base Level Habitat Restoration

This alternative emphasizes a base level of habitat restoration to improve ecosystem health and increase populations of special status species. Healthy populations of these species, including Delta smelt and winter-run chinook salmon, will be better able to withstand the impacts of Delta water export operations. Restoration of leveed lands to tidal shallow water habitat would provide new habitat for native fish species. Levee improvements will be made in ways that reduce system vulnerability while restoring nearshore aquatic habitat, as well as riparian vegetation. Long-term programs to manage subsidence will also reduce vulnerability. Source control of pollutants will increase water quality for all beneficial uses.

Habitat improvements will be made throughout the watershed to improve ecosystem quality and aid the recovery of species of special concern. In-Delta levee water side and land side modifications to provide shallow water habitat and riparian habitat will be made at many sites. Dredge material will be used to recreate new shallow water habitat out of deeper Delta island habitat. A long-term program to manage subsidence will be implemented. Habitat improvements will also be made to diked wetlands and tidal wetlands between Collinsville and Carquinez Strait. Water supply reliability and Delta species will both benefit from habitat improvements and levee protection. Operation of Clifton Court Forebay will be modified to reduce intake of fish. Delta water quality will be improved through agricultural, industrial, and municipal wastewater reclamation and reuse, timing and dilution of releases of poor quality agricultural drainage, and better source control.

Physical and Structural Actions

Delta Levee Habitat Restoration— Restore approximately 100 levee miles of shallow water, riverine and riparian habitat in the Delta to provide forage and cover habitat for resident and anadromous fish, and to provide other benefits associated with riparian habitat. Actions might include setback levees, creation of berms, creation of shallow water habitat, and increased vegetation on levees. Considerations for site selection will include distance from hazards such as pumping plants, protection from waves generated by wind and boat wakes, importance of island integrity to the maintenance of Delta water quality, and need to improve channel capacity and structural stability of levees. Good candidate areas are Twitchell Island along Three Mile Slough and Seven Mile Slough, Georgiana Slough, and the north and south forks of the Mokelumne River.

Delta Habitat Restoration— Restore shallow water and tidal wetland habitat in the Delta to provide spawning areas, forage areas, and escape cover for juvenile salmon, Delta smelt, splittail, and other species. Candidate areas include Prospect Island, Liberty Island, Little Holland Tract, Decker Island, Hastings Tract, Yolo Bypass, and the southeast Delta. Also restore shallow water shoreline habitat along margins of the lower Sacramento and San Joaquin channels, and tributary sloughs including Barker Slough, Lindsey Slough, and Parker Island. Riparian, wetland, and terrestrial habitat would also be restored on Delta islands and upland areas adjacent to river channels.

Bay Habitat Restoration— Restore about 1,000 acres of tidal wetlands between Collinsville and Carquinez Strait. Actions may include conversion of diked wetlands to tidal wetlands or use of dredge spoils to create wetland areas. The resulting habitat types will provide wet year spawning habitat for Delta smelt, rearing areas for salmon, as well as habitat for diverse wildlife including canvasback and redhead ducks.

Install Bypass at Mouth of Old River—Construct a bypass at the mouth of Old River that will encourage outmigrants to stay in San Joaquin River while allowing a managed flow down Old River.

Fish Screens—Install fish screens on diversions over 250 cfs that are on fish migration routes in the Delta, rivers, and tributaries.

Other Programs—Implement recommended habitat restoration actions from other programs, including CVPIA and the Anadromous Fish Restoration Plan. Examples of specific actions include small dam removal on Clear Creek, dam removal on Battle Creek, establishment of a population of winter run chinook salmon on Battle Creek.

Sacramento River Habitat Restoration—Provide for USCE matching funds to conduct a feasibility study for habitat restoration on the Sacramento River from Sacramento to Collinsville. Study is a 50/50 cost share. The construction is 75 percent USCE match. Feasibility study will take 2 years and cost around $2M. Make restoration non-homogenous and allow for recreation sites.

Management and Operation

Real time monitoring—Establish an adequate real-time monitoring to determine location of species of special concern so that project operations can be effectively managed to reduce losses of fish and minimize effects on habitat.

Acoustic Barrier at Mouth of Georgiana Slough—Operate an acoustic barrier at the mouth of Georgiana Slough. Work to improve the effectiveness of behavioral barriers. Evaluate use of acoustic barriers at the Delta Cross Channel and 3-Mile Slough.

Modify Clifton Court Forebay Operation—Modify operations of Clifton Court Forebay so that it does not entrain as many fish into the forebay during typical "Big Gulp" operation. Install regulating gates into Italian Slough so that water can be drawn in over time at a lower velocity. This will reduce the number of fish lost to predation in the forebay.

Implement a Subsidence Management Program— Develop and implement a very long-term subsidence management program that prescribes land use strategies related to the degree of subsidence. For some deep Delta islands (below -10 feet in elevation) eliminate traditional agriculture in favor of seasonal wetland management to stop and reverse subsidence. At elevations from -10 to -3 feet, stabilize subsidence by rotating seasonal wetland with wildlife-friendly agricultural use. At elevations from -3 to +3 feet, maintain agricultural uses on some parcels, identify other areas for restoration to tidal wetlands.

Mark Hatchery Fish — Mark salmon produced in hatcheries to facilitate selective catch by commercial and recreation fisheries.

Pen Rearing of Striped Bass — Rear striped bass in pens to maintain recreational fishery and avoid operational constraints on water projects due to spawning bass.

Response Program for Exotic Species Control— Establish and fund a rapid response program among environmental agencies to provide a fast and effective means of managing exotic species introduced to the Bay-Delta. Carry out continuing management programs for nuisance species such as water hyacinth.

Mine Drainage Remediation—Remediate discharges from abandoned mines in tributaries of the upper Sacramento River downstream of Shasta Dam to the maximum extent reasonably possible.

Management of Water Quality—Implement actions such as source control regulations for agricultural drainage, retiring lands with drainage problems, and other cost-effective management of urban, agricultural, and industrial discharges and runoff to improve Delta water quality.

Institutional and Policy

Water Quality Standards — Maintain current standards for Delta water quality and position of X2.

Preserve Agricultural Land Uses— Establish programs to preserve agricultural land uses that help to protect the ecosystem. Examples include limiting levee restoration to levels that are inadequate to permit residential construction on Delta islands, and incentive programs to preserve habitats such as pasture, which is important for sandhill cranes.

CALFED Regulatory Team—Determine how to implement a regulatory team to facilitate getting permits for environmental restoration projects. Each member agency would have a key person on team.

Dredge Materials—Establish a policy that all future clean dredge material out of the Delta above Chipps Island should go into Delta restoration projects.

Safe Harbor for Maintenance— Encourage farmers and levee maintenance districts to leave habitat areas undisturbed when feasible by providing protection from ESA provisions.

Preliminary Assessment

Ecosystem Quality—This alternative will enhance ecosystem quality through restoration and enhancement of riverine, riparian, wetland, and adjacent terrestrial habitat. Expansion of floodway habitat and channels in the Bay-Delta will help to restore fish spawning, rearing, and feeding habitats and improve fish survival. Improvements to Clifton Court Forebay will also help in reducing the numbers of fish diverted into the forebay and increasing survival of fish that are

drawn into the forebay. Though improvements to habitat and fish survival wll benefit ecosystem quality, complete restoration of important fish populations may not be possible without reducing the use of the Delta as a water supply conduit and greatly reducing exports from the south Delta.

Water Supply—This alternative provides limited improvement to the reliability of water supply by increasing fish populations (through habitat improvements and reduce diversion effects).

Water Quality—This alternative relies on core actions including point and non-point source controls and mine drainage remediation to improve water quality.

System Vulnerability—Creation of shallow water habitat simultaneously with levee reconstruction provides better levees and protection for adjacent land uses. Improvement of the levees around the critical western islands protects those islands as well as protecting in-Delta and agricultural export water supplies from salinity intrusion due to island failure.

Alternative EQ-5

Group
Ecosystem Quality

Title
Reduce Diversion Effects and Habitat Creation Sacramento Ship Channel and Small Transfer Facility

This alternative focuses on increasing populations of anadramous and Bay-Delta native fish to eliminate to the maximum extent possible export curtailments due to "take" caused by the export pumps and non-project associated losses. To avoid entrainment of Delta Smelt the diversion for M&I purposes is moved from the south-Delta to a location upstream in the Sacramento River. Populations will be increased through habitat improvement and creation, environmental water purchases and exchanges, in Delta storage, and diversion operational changes. Habitat will be created in the river systems upstream from the Delta, in Delta and in areas west of the Delta. Water purchases and exchanges will be made that will allow the fisheries agencies, at their discression, to move fish in the delta. This water would used in concert with an in-Delta storage facility. Operations at Clifton Court forebay would be adjusted to reduce fish attraction into the forebay.

Riverine, riparian, wetland, and adjacent terrestrial habitat will be restored and enhanced on the Sacramento and San Joaquin Rivers at the most feasible and productive sites. In-Delta levee water side and land side modifications to provide shallow water habitat and riparian habitat will be made at the most productive sites. Dredge material will be used to recreate new shallow water and Delta island habitat. Some long term conversion of land use of islands to wetland habitats will be implemented. About 100,000 acre feet would be purchased form the San Joaquin River System to be used by the fisheries agencies to flush fish at critical times or to exchange with export water when needed. South of Delta storage for environmental exchange water would be developed. This allows for flexibility of exchange with San Joaquin users. In.-Delta storage would be developed (around 200,000 to 300,000 acre feet) that would be used to provide water to the export pumps at critical fish migration times. Operation of the Clifton Court Forebay would be modified to reduce intake of fish at critical times. Additional shallow water habitat would be developed near the Van Sickle- Montezuma Island area using clean dredge spoils form the Delta.

A small isolated facility will be constructed with a diversion in the Sacramento River upstream of the "Critical Habitat for Delta Smelt" at the Sacramento Weir. This screened diversion will divert around 10,000 cfs into a canal that connects to the Sacramento Ship Channel. The ship channel will be converted from an conveyance for shipping to a M&I water conveyance facility. At the ship channels southern terminus the water will be conveyed by siphons and canals, across the Delta to the south Delta pumps. Direct connections could be made to North Bay Aqueduct, Contra Costa Canal, and the South Bay Aqueducts and exchanges made that could improve the operational flexibility of the Delta pumps to minimize fish impacts.

Water supply reliability for M&I would greatly increase due to the diversion location above smelt habitat and new technology screening for winter run. Water supply reliability would also improve at the pumps because of the increased flexibility the fishery agencies have to move fish away from the pumps and by levee protection measures. Water quality for Delta water quality is improved through agricultural, industrial, and municipal wastewater reclamation and reuse. The vulnerability of Delta land use, Delta water supply, agricultural export water supply and Delta

ecosystem function to catastrophic failure is reduced by improving levees on critical western islands, and elsewhere.

Physical and Structural Actions

Delta Levee Habitat Restoration— Restore approximately 100 levee miles of shallow water, riverine and riparian habitat in the Delta to provide forage and cover habitat for resident and anadromous fish, and to provide other benefits associated with riparian habitat. Actions might include setback levees, creation of berms, creation of shallow water habitat, and increased vegetation on levees. Considerations for site selection will include distance from hazards such as pumping plants, protection from waves generated by wind and boat wakes, importance of island integrity to the maintenance of Delta water quality, and need to improve channel capacity and structural stability of levees. Good candidate areas are Twitchell Island along Three Mile Slough and Seven Mile Slough, Georgiana Slough, and the north and south forks of the Mokelumne River.

Delta Habitat Restoration— Restore shallow water and tidal wetland habitat in the Delta to provide spawning areas, forage areas, and escape cover for juvenile salmon, Delta smelt, splittail, and other species. Candidate areas include Prospect Island, Liberty Island, Little Holland Tract, Decker Island, Hastings Tract, Yolo Bypass, and the southeast Delta. Also restore shallow water shoreline habitat along margins of the lower Sacramento and San Joaquin channels, and tributary sloughs including Georgiana Slough, Barker Slough, Lindsey Slough, and Parker Island. Riparian, wetland, and terrestrial habitat would also be restored on Delta islands and upland areas adjacent to river channels.

Sacramento River Habitat Restoration—Restore habitat and geomorphic processes along the Sacramento River upstream of the Delta to increase survival and spawning success of anadromous fish, and to provide other benefits. Construct segments of meander belt where feasible (such as Red Bluff to Colusa) and restore segments of riparian habitat in more controlled stretches of the river (Colusa to Knights Landing.)

San Joaquin River Habitat Restoration— Restore channel features to improve fish survival. Actions may include restoration of deeper, narrower channel areas to keep water cooler, and isolation of quarry areas to protect young fish from predation and straying.

Bay Habitat Restoration— Restore about 5,000 acres of tidal wetlands between Collinsville and Carquinez Strait. Actions may include conversion of diked wetlands to tidal wetlands or use of dredge spoils to create wetland areas. The resulting habitat types will provide wet year spawning habitat for Delta smelt, rearing areas for salmon, as well as habitat for diverse wildlife including canvasback and redhead ducks.

Channel Islands—Restore and protect channel islands. Evaluate contribution of upstream meander belts to sediment deposition at channel islands. Establish zones for different types of boating use so some areas are protected from large boat wakes.

In-Delta Storage close to the Pumps—Convert one or more Delta islands such as Bacon Island, Mandeville Island, or Victoria Island into a reservoir to provide operational flexibility and generate up to 300,000 acre feet of storage. The levee around the storage reservoir will be up to

B-004675

several hundred feet wide to support riparian forest cover and provide opportunities for creation of pockets of shallow water habitat. The shallow inward slopes of the levees might support water grass habitat for migratory waterfowl, depending on reservoir operation. The reservoir might be suitable for Sacramento perch habitat. Water will be diverted onto islands through screened diversions during the months of November, December or January depending on the type of water year. Water will be released from March to July to provide water to the pumps at times when project operations would otherwise draw fish into the Delta or to the pumps. Water may also be used to provide other fisheries benefits.

New Diversion—Construct a diversion with a state-of-the-art fish screen above Sacramento near the Sacramento Weir. The diversion would be located upstream from critical Delta Habitat and would be sized to divert around 10,000 cfs without danger to "winter run".

Sacramento Ship Channel Conveyance—Construct a conveyance canal from the weir to the upper end of the Sacramento Ship Channel. Convert the use of the Ship Channel into a water conveyance facility.

Cross Delta conveyance facility—At the ship channels southern terminus the water will be conveyed by siphons and canals, across the Delta to the south Delta pumps. Direct connections could be made to North Bay Aqueduct, Contra Costa Canal, and the South Bay Aqueducts and exchanges made that could improve the operational flexibility of the Delta pumps to minimize fish impacts.

Install Bypass at Mouth of Old River—Construct a bypass at the mouth of Old River that will encourage outmigrants to stay in San Joaquin River while allowing a managed flow down Old River.

Fish Screens—Install fish screens on diversions over 100 cfs that are on fish migration routes in the Delta, rivers, and tributaries.

Other Programs—Implement recommended habitat restoration actions from other programs, including CVPIA and the Anadromous Fish Restoration Plan. Examples of specific actions include small dam removal on Clear Creek, dam removal on Battle Creek, establishment of a population of winter run chinook salmon on Battle Creek.

Sacramento River Habitat Restoration—Provide for USCE matching funds to conduct a feasibility study for habitat restoration on the Sacramento River from Sacramento to Collinsville. Study is a 50/50 cost share. The construction is 75 percent USCE match. Feasibility study will take 2 years and cost around $2M. Make restoration non-homogenous and allow for recreation sites.

Levee Upgrades—Provide landside buffer zones of 50 to 75 yards to minimize levee subsidence for islands providing valuable existing habitat, such as on Bradford Island. Improve levee maintenance and stabilization to at least National Flood Insurance Program standards (NFIP; 100-year flood protection) for all islands, such as Tyler and Mandeville, containing existing infrastructure and/or land use that provides economic benefit to the region. Improve levee maintenance and stabilization to at least Bulletin 192-82 or PL-99 standards (generally considerably more than 100-year flood protection) for critical western Delta islands, such as

Brannan-Andrus, Bethel, and Sherman, to reduce risk to critical infrastructure (e.g. Mokelumne Aqueduct, PG&E gas lines, Highway 160) and to reduce risk to export water quality from salinity intrusion due to levee failure. A levee management plan would provide necessary funding for ongoing maintenance and emergency funding and direction to reclaim Delta islands in the event of inundation in order to continue protection of Delta functions as an integrated resource system.

Management and Operation

Obtain environmental water—Obtain approximately 100,000 acre feet from San Joaquin water users to be used for fisheries benefits. Uses might include pulses to aid fish movement, dilution of poor quality San Joaquin River flows, or exchange with export customers at critical times so Delta exports could be curtailed. South of Delta storage for environmental exchange water might need to be developed. This would allow for flexibility of exchange with San Joaquin users.

Real time monitoring—Establish an adequate real-time monitoring to determine location of species of special concern so that project operations can be effectively managed to reduce losses of fish and minimize effects on habitat.

Acoustic Barrier at Mouth of Georgiana Slough—Operate an acoustic barrier at the mouth of Georgiana Slough. Work to improve the effectiveness of behavioral barriers. Evaluate use of acoustic barriers at the Delta Cross Channel and 3-Mile Slough.

Storage of Agricultural Tile Drain Water—Develop a program with irrigation districts to store tile drain water to be released at times when pulse flows can provide dilution.

Modify Clifton Court Forebay Operation—Modify operations of Clifton Court Forebay so that it does not entrain as many fish into the forebay during typical "Big Gulp" operation. Install regulating gates into Italian Slough so that water can be drawn in over time at a lower velocity. This will reduce the number of fish lost to predation in the forebay.

Implement a Subsidence Management Program— Develop and implement a very long-term subsidence management program that prescribes land use strategies related to the degree of subsidence. For some deep Delta islands (below -10 feet in elevation) eliminate traditional agriculture in favor of seasonal wetland management to stop and reverse subsidence. At elevations from -10 to -3 feet, stabilize subsidence by rotating seasonal wetland with wildlife-friendly agricultural use. At elevations from -3 to +3 feet, maintain agricultural uses on some parcels, identify other areas for restoration to tidal wetlands.

Mark Hatchery Fish — Mark salmon produced in hatcheries to facilitate selective catch by commercial and recreation fisheries.

Pen Rearing of Striped Bass — Rear striped bass in pens to maintain recreational fishery and avoid operational constraints on water projects due to spawning bass.

Response Program for Exotic Species Control— Establish and fund a rapid response program among environmental agencies to provide a fast and effective means of managing exotic species

introduced to the Bay-Delta. Carry out continuing management programs for nuisance species such as water hyacinth.

Mine Drainage Remediation—Remediate discharges from abandoned mines in tributaries of the upper Sacramento River downstream of Shasta Dam to the maximum extent reasonably possible.

Management of Water Quality—Implement actions such as source control regulations for agricultural drainage, retiring lands with drainage problems, and other cost-effective management of urban, agricultural, and industrial discharges and runoff to improve Delta water quality.

Institutional and Policy

Water Quality Standards — Maintain current standards for Delta water quality and position of X2.

Preserve Agricultural Land Uses— Establish programs to preserve agricultural land uses that help to protect the ecosystem. Examples include limiting levee restoration to levels that are inadequate to permit residential construction on Delta islands, and incentive programs to preserve habitats such as pasture, which is important for sandhill cranes.

CALFED Regulatory Team—Determine how to implement a regulatory team to facilitate getting permits for environmental restoration projects. Each member agency would have a key person on team.

Dredge Materials—Establish a policy that all future clean dredge material out of the Delta above Chipps Island should go into Delta restoration projects.

Safe Harbor for Maintenance— Encourage farmers and levee maintenance districts to leave habitat areas undisturbed when feasible by providing protection from ESA provisions.

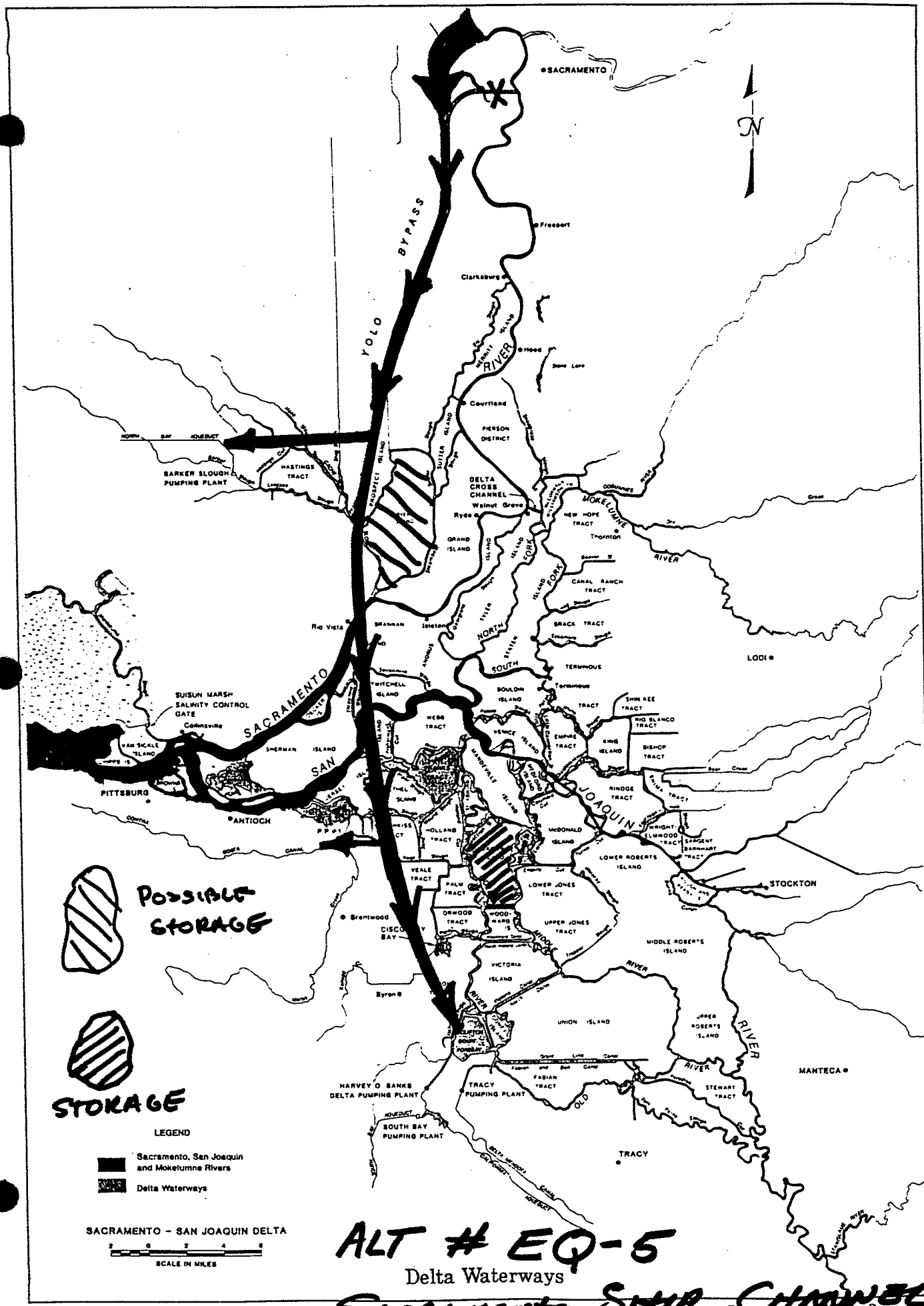
Preliminary Assessment

Ecosystem Quality—This alternative will greatly enhance ecosystem quality through restoration and enhancement of riverine, riparian, wetland, and adjacent terrestrial habitat. Expansion of floodway habitat, channels, and meander belts in the Bay-Delta and upstream in rivers and tributaries will help to restore fish spawning, rearing, and feeding habitats and improve fish survival. Purchased fish water from the San Joaquin will greatly enhance the fisheries agencies' ability to assist fish passage from the rivers through the Delta. The in-delta storage will add flexibility for exchange with export water to reduce the cross Delta movement of fish toward south Delta pumping plants. Improvements to Clifton Court Forebay will also help in reducing the numbers of fish diverted into the forebay and increasing survival of fish that are drawn into the forebay. Though great improvements to habitat and fish survival will occur, complete restoration of important fish populations may not be possible without reducing the use of the Delta as a water supply conduit and greatly reducing exports from the south Delta. Moving a major portion of the south Delta diversions to screened locations upstream of the Delta will also reduce impacts on fisheries.

Water Supply—This alternative improves water supply and reliability by relocating a large portion of the south-Delta diversion outside the Delta, the full capacity of the existing export pumps would be available for agricultural diversions, increasing the supply and availability of water to agricultural exporters. Moving a major portion of the south Delta diversions to screened locations upstream of the Delta will also reduce impacts on fisheries. This alternative also improves the reliability of water supply by providing for the release of south Delta storage during key seasons, by increasing fish populations (through habitat improvements and reduce diversion effects), and by using stored and exchanged water to help avoid interruptions in pumping.

Water Quality—This alternative improves M&I export water quality by relocating the diversion upstream of the Delta. Delta water quality is improved through reclamation of agricultural, municipal, and industrial wastewater. Other water quality improvements are achieved by point and non-point source controls and mine drainage Remediation to improve water quality.

System Vulnerability—Relocating M&I export facilities outside of the Delta essentially eliminates the risk that operations will be interrupted by a failure of in-Delta facilities. Creation of shallow water habitat simultaneously provides better levees and protection for adjacent land uses. Improvement of the levees around the critical western islands protects those islands as well as protecting in-Delta and agricultural export water supplies from salinity intrusion due to island failure. Other core actions improve the reliability of in-Delta facilities through levee management, and levee reconstruction.



B—004680

B-004680

Quality

B-004681

WATER QUALITY ALTERNATIVES	Improved Source Controls	Manage Pollutant Flows	Timing of Releases	Timing of Diversions	Adding Storage	Installing Barriers		Islands - Convey & Storage	East Side Canal - Convey	Water Transfers	Improve Natural Flood Protection	Reduce Demands and Increase Instream Flows	*Reduce Effects of Diversions*	GW Banking & Conjunctive Use	Improve Island & Levee Maintenance & Stabilization	Habitat Restoration			
1. Pollutant Source Controls and Salinity Management	⊛	⊛	○	○							○	○		○	○	⊛			
2. Improve Delta Flow Management Through Operational Modifications	○	○	⊛	⊛		○						⊛		⊛	○	○			
3. In-Delta Flow Management Using Added Upstream Storage	⊛		⊛		⊛	⊛				○	⊛	○	○		○	⊛			
4. Chain-of-Lakes Isolated Facilities	○		○					⊛		○		○	⊛		⊛	○			
5. East Side Delta Isolated Facilities	○		○						⊛	○		○	⊛		○	○			

⊛ Key Action

○ Supporting Action

726.0610.CALFED.1/96.KEJ

Alternative WQ-1

Group
Water Quality

Title
Pollutant Source Controls and Salinity Management

Many of the problems in the Delta originate because of poor water quality caused by a combination of agricultural, urban, industrial, and naturally occurring pollutant sources, insufficient flows and circulation patterns that create "reverse flows" and "null" zones, and saltwater intrusion from the ocean into the Delta. Salinity levels are a water quality parameter of concern for agricultural, urban, and industrial Delta water users; suspended solids are of concern to agriculture; and organic carbon and pollutants are of concern to urban users. The theme of this alternative is to manage pollutant sources, including salinity, and to increase water quality within the Bay-Delta. By greatly improving the control of contamination sources, improvements to water quality are achieved for all beneficial uses of Delta waters: drinking water uses, agricultural water uses, and environmental water uses. Key elements of this approach include identification of problem pollutants and their sources, and selection and implementation of appropriate source controls and management techniques. This alternative emphasizes improved management and describes a non-structural approach to improving water quality.

Actions selected to support this alternative are those actions which limit pollutants at the source and better manage the system to control contaminants before they are released into receiving waters. Examples of best management practices to be applied in the watersheds include land fallowing in areas with agricultural drainage problems, and integrated pest management. Source control can reduce the mass loads of contaminants entering the Delta system, however, not all contaminants can be prevented from entering the Delta. Better management of pollutant flows (such as agricultural return flow treatment and construction of wetlands as filtration systems) also will reduce the influx of pollutants into the aquatic system. Core actions related to improving and protecting existing aquatic, riparian, and wetland habitats in the Bay-Delta system and upstream will be implemented, resulting in both the direct water quality benefits of restoring natural functions of degraded habitat, and improvements in overall ecosystem quality.

Key Actions

Source Controls

Improve Pollutant Source Controls— Existing source control regulations for pollutants may not be sufficiently comprehensive nor enforced to levels required to protect beneficial uses in the Bay-Delta system and tributary rivers. These actions would provide for an array of increased source reduction activities such as additional regulation of

agricultural and urban drainage and better enforcement, establishing BMP's for a range of activities affecting Delta water quality such as levee maintenance and pest control practices, and supporting and enhancing existing land retirement and fallowing programs.

Using a watershed management approach, identify and control high priority pollutant sources through a combination of source reduction and treatment actions. Provide regulatory incentives and develop institutional agreements to enable focusing resources on priority sources. Intense application of core level actions such as implementing source control regulations for pollutants, retirement of lands with serious drainage disposal problems, retirement or fallowing agricultural lands with salt or other contaminant drainage problems to reduce land-derived salt contamination, management of irrigation tailwater, retention and management of stormwater runoff, and management of discharges from abandoned mining sites would improve water quality management.

Implement on-site mine drainage remediation measures based on requirements in current regulations. Through changes in water pollution requirements give urban areas flexibility to fund high-priority mine cleanup in lieu of increasing expenditures on treatment plant improvements.

Better Manage Pollutant Flows

Control Volume of Agricultural Discharges— Selected agricultural water quality management measures, such as those directed at drainage volume control, can reduce agricultural water demands and increase in-Delta flows. Exporting agricultural drainage from the San Joaquin Valley to the least sensitive locations in the ocean or salt sinks will greatly reduce water quality problems in the San Joaquin River and southern Delta while minimizing impairment of agricultural lands and resultant losses in production.

Manage Irrigation Tailwater to Reduce Pesticides— Utilize wetlands, treatment processes, or holding reservoirs to store or retard surface agricultural drainage, reduce pesticide concentrations, and/or make releases during higher instream flow periods.

Retain and Manage Stormwater Runoff— Create wetlands, buffer strips, treatment processes, or holding reservoirs to reduce contaminant concentrations and to store or retard contaminated flows and stormwater drainage for release during periods of higher instream flows.

Constructing Wetlands— Utilize wetlands for natural treatment and detention to reduce contaminant concentrations and make releases during periods of higher instream flows.

Habitat Restoration

Bay-Delta Habitat Restoration— Restoration of Bay-Delta habitat would rely on core-level implementation of actions such as protecting existing shallow habitat from erosion, restoring/preserving channel islands, modifying levee maintenance practices, and expansion of wetland acquisition programs.

Upstream Habitat Restoration— Restoration of upstream habitats would rely on core-level implementation of actions such as restoring spawning gravels in high-priority upstream anadromous fish habitats, restoring high-priority sites for riparian vegetation, and improving fish passage at high-priority problematical barriers.

Supporting Actions

Modify Timing of Releases — Using real time monitoring and adaptive management, manage upstream reservoir releases from New Melones, Folsom, and other reservoirs, both seasonally and annually, to improve Delta water quality through dilution to provide higher levels of water quality protection. Implementation is at a higher level than the core actions reflect. Modify downstream reservoir releases, and groundwater storage releases in Sacramento and San Joaquin Valleys and in export service areas to improve water quality while also providing, to a lesser degree of emphasis, instream habitat benefits such as improved temperature levels and improved instream flows to support aquatic habitat.

Modify Timing of Diversions— To improve Delta water quality, manage the timing of Delta and export diversions to maximize Delta flows during poor water quality conditions. Increase export capacities and/or rates when and where flows are not needed for water quality improvements (e.g. divert more in winter time). Install fish screens to reduce entrainment effects in selective locations as well as increase groundwater storage usage, both of which maximize diversion potential.

Reduce Water Demand on Delta and Increase In-Stream Flows— Use a variety of actions involving increased agricultural, municipal, and industrial conservation and reclamation; acquisition of supplemental water; and expanded use of desalination with the intent of relocating the freed water supplies for use as in-stream dilution flows and to reduce salinity levels. Conservation strategies would include encouraging land fallowing and water pricing measures. The freed up supplies would then be available to provide water quality protection through dilution and habitat improvements such as improved temperature and pulse flows during critical migration periods.

Improve Natural Flood Protection— Enhance levee flood protection and create new habitat by allowing rivers to meander, relocating levees to create floodways, and modifying floodways to support wetland habitats.

Groundwater Banking and Conjunctive Use— Expanding conjunctive use programs will increase the availability of water supplies and increase flexibility in the timing of diversions and exports.

Levee and Channel Improvements— Implement core actions at a minimum level to improve system reliability through channel improvements and levee maintenance and stabilization by modifying agricultural practices to reduce subsidence, providing funding for maintenance and stabilization, and maintaining or reconstructing levees around infrastructure. These actions would reduce the risk to the water supply, water quality, ecosystem quality, and existing land uses and infrastructure of the Bay-Delta system. Levee improvements would focus on levee dimensions (including height above the flood water surface) and the creation of stabilizing berms. These berms would be constructed on the landside or waterside. Waterside berms would be constructed solely to enhance aquatic habitat, but only if they do not interfere with conveyance of adjacent channels. Actions to control subsidence adjacent to the levees could include modifying agricultural practices adjacent to levees or creating landside habitat. Channel maintenance would improve conveyance of flood flows through the Delta and could include efforts to restore aquatic habitats in combination with waterside berms where current habitat is inadequate.

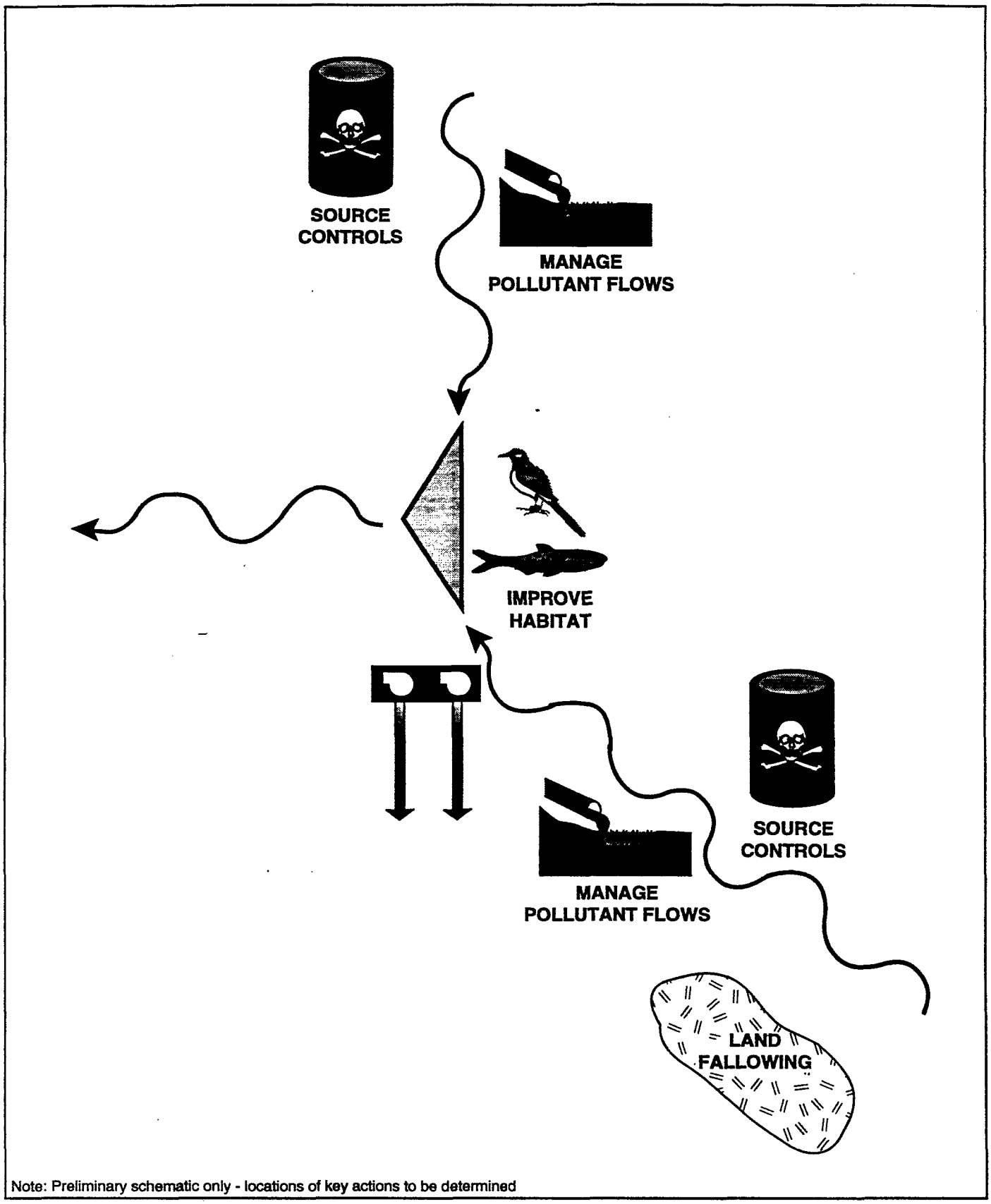
Preliminary Assessment

Ecosystem Quality— The key and supporting actions included in this alternative result in improved ecosystem quality. Habitat creation and protection is accomplished throughout the watershed, flows and timing for habitat and species are improved and major reductions in pollutants entering the system improve the quality of existing water supply for both habitat and economic uses.

Water Supply— This alternative improves export water supply reliability by reducing reliance on the Delta as a source of water supply between X and X percent for M&I needs and between X and X percent for agricultural needs, through demand reductions and development of alternative sources of supply. Delta water supply reliability is also improved through channel improvements and levee maintenance and stabilization actions and in particular from salinity intrusion by protecting the critical Delta western Islands.

Water Quality— By greatly improving the control of sources of contamination, improvements to water quality are achieved for all beneficial uses of Delta water: drinking water uses, agricultural water uses, and environmental water uses.

System Vulnerability— Supporting actions to improve levee maintenance and stability and to improve natural flood protection significantly reduce the vulnerability of the system.



Note: Preliminary schematic only - locations of key actions to be determined

726.0610 CALFED 1/96 KEJ

CALFED

WQ-1

POLLUTANT SOURCE CONTROLS AND SALINITY MANAGEMENT

MONTGOMERY WATSON

B—004687

B-004687

Alternative WQ-2

Group
Water Quality

Title
Improve Delta Flow Through Operational Modifications

Many of the problems in the Delta originate because of poor water quality caused by a combination of agricultural, urban, industrial, and naturally occurring pollutant sources, insufficient flows and circulation patterns that create "reverse flows" and "null" zones, and saltwater intrusion from the ocean into the Delta. Salinity levels are a water quality parameter of concern for agricultural, urban, and industrial Delta water users; suspended solids are of concern to agriculture; and organic carbon and pollutants are of concern to urban users. The theme of this alternative is to improve water quality in the Bay-Delta to the maximum extent achievable utilizing only operational modifications to the upstream and Delta storage, conveyance, and diversion systems. Key actions include modifying the timing of releases and diversions, and increasing the utilization of groundwater banking and conjunctive use. These operational modifications are intended to improve reservoir storage and releases, and manage the timing of diversions to optimize water quality within the constraints of the available actions. Supporting actions include source controls, management of pollutant flows, installation of barriers, conservation, and habitat improvement. This alternative achieves water quality benefits by integrating actions related to water supply and ecosystem quality with those that improve flow conditions for water quality control.

Improving water quality by focusing on operational modifications to the storage, conveyance, and diversion system requires development of real time flow monitoring and management of the system. Reservoir operations would be modified in response to water quality conditions in the Delta, especially salinity. Generally, releases could be modified to increase summer and fall flows through the Delta while providing for specific modifications to meet the needs of localized water quality problem areas such as the south Delta. The timing of Delta and export diversions would also be managed more precisely during seasonal and localized poor water quality conditions, through implementation of various actions with an emphasis on an increase in conjunctive use programs. Increasing ground water storage and optimizing conjunctive use programs to capture high flows during the early winter months (which are then utilized during summer months) allows for a decrease in diversions from the Delta during the critical late winter, spring and summer months, thus increasing operational flexibility to improve water quality. Supporting and core actions that are fully-consistent with the theme of operational modifications would be implemented at a higher level than those actions that are related to and supportive of the theme.

Key Actions

Modify Timing of Releases— Using real time monitoring and adaptive management, manage upstream reservoir releases from New Melones, Folsom, and other reservoirs both seasonally and annually to improve Delta water quality through dilution of land- and activity-derived contaminants, and ocean salinity repulsion. Implementation is at a higher level than the core actions reflect. Modify Sacramento and San Joaquin Valley as well as export area reservoir releases and groundwater storage releases in conjunction with upstream operations to accommodate system demands. Focus the timing of releases on water quality improvements while also providing (to a lesser degree of emphasis) instream aquatic habitat benefits such as improved temperature levels and optimal flows.

Modify Timing of Diversions— To improve Delta water quality, manage the timing of Delta and export diversions to increase selected Delta channel flows during poor water quality conditions. Increase export capacities and/or rates when and where flows are not needed for water quality improvements such as during surplus flow conditions in wet winters. Install fish screens to reduce entrainment effects in selective locations when diversions are needed. Increase groundwater storage capacity and conjunctive use to maximize use of Delta diversion potential when water is available without environmental cost, and reduce it when the environmental costs are significant.

Increase Storage with Ground Water Banking and Conjunctive Use— Expand groundwater storage and conjunctive use programs throughout the upstream watersheds and service areas to maximize the full capability to respond to operational requirements utilizing the full capabilities and flexibility of the existing system and alternative modifications.

Reduce Water Demand on Delta and Increase In-Stream Flows— Use a variety of actions involving increased agricultural, municipal, and industrial conservation and reclamation; acquisition of supplemental water; and expanded use of desalination with the intent of reallocating the freed-up water supplies for use as instream dilution flows. Conservation strategies would include encouraging land fallowing and water pricing measures. The freed-up supplies would then be available to provide water quality protection through dilution and habitat improvements such as improved temperature and pulse flows during critical migration periods.

Supporting Actions

Improve Pollutant Source Controls— Existing source control regulations for pollutants may not be sufficiently comprehensive nor enforced to levels required to protect beneficial uses in the Bay-Delta system and tributary rivers. These actions would provide

for an array of increased source reduction activities such as additional regulation of agricultural and urban drainage and better enforcement, establishing BMP's for a range of activities affecting Delta water quality such as levee maintenance and pest control practices, and supporting and enhancing existing land retirement and fallowing programs.

Using a watershed management approach, identify and control high priority pollutant sources through a combination of source reduction and treatment actions. Provide regulatory incentives and develop institutional agreements to enable focusing resources on priority sources. Intense application of core level actions such as implementing source control regulations for pollutants, levee maintenance best management practices to encourage use of materials compatible with good water quality, retirement of lands with serious drainage disposal problems, retirement or fallowing agricultural lands with salt or other contaminant drainage problems to reduce land-derived salt contamination, management of irrigation tailwater, retention and management of stormwater runoff, and management of discharges from abandoned mining sites would improve water quality management.

Implement on-site mine drainage remediation measures based on requirements in current regulations. Through changes in water pollution requirements give urban areas flexibility to fund high-priority mine cleanup in lieu of increasing expenditures on treatment plant improvements.

Manage Pollutant Flows

Manage Irrigation Tailwater to Reduce Pesticides— Utilize wetlands, treatment processes, or holding reservoirs to store or retard surface agricultural drainage, reduce pesticide concentrations, and/or make releases during higher instream flow periods.

Retain and Manage Stormwater Runoff— Utilize wetlands, treatment processes, or holding reservoirs to reduce contaminant concentrations and to store or retard contaminated flows and stormwater drainage for release during periods of higher instream flows.

Construct Wetlands— Utilize wetlands for natural treatment and detention to reduce contaminant concentrations and make releases during periods of higher instream flows.

Install Barriers— Construct flow and fish barriers to better manage water movement in the Delta, minimize reverse flows and salinity intrusion, and facilitate fish migration into and from the Delta. Potential fish barrier locations include the Delta Cross Channel, Georgiana Slough, and Threemile Slough. Construct tide gates and/or flow barriers in the

southern Delta to better manage south Delta water quality. Operation of the fish barriers will be coordinated with assistance from real time monitoring of anadromous fish population and movement.

Levee and Channel Improvements— Implement core actions at a minimum level to improve system reliability through channel improvements and levee maintenance and stabilization by modifying agricultural practices to reduce subsidence, providing funding for maintenance and stabilization, and maintaining or reconstructing levees around infrastructure. These actions would reduce the risk to the water supply, water quality, ecosystem quality, and existing land uses and infrastructure of the Bay-Delta system. Levee improvements would focus on levee dimensions (including height above the flood water surface) and the creation of stabilizing berms. These berms would be constructed on the landside or waterside. Waterside berms would be constructed solely to enhance aquatic habitat, but only if they do not interfere with conveyance of adjacent channels. Actions to control subsidence adjacent to the levees could include modifying agricultural practices adjacent to levees or creating landside habitat. Channel maintenance would improve conveyance of flood flows through the Delta and could include efforts to restore aquatic habitats in combination with waterside berms where current habitat is inadequate.

Restore Delta and Upstream Habitat— Create a variety of habitat types upstream of and within the Delta by protecting, enhancing, and creating new instream, wetland, riparian, and terrestrial habitats, while balancing drinking water taste, odor, and treatment concerns associated with nutrients. Wetland habitats are especially useful for the natural treatment of contaminants.

Core Actions

This alternative assumes that the Core Actions are implemented.

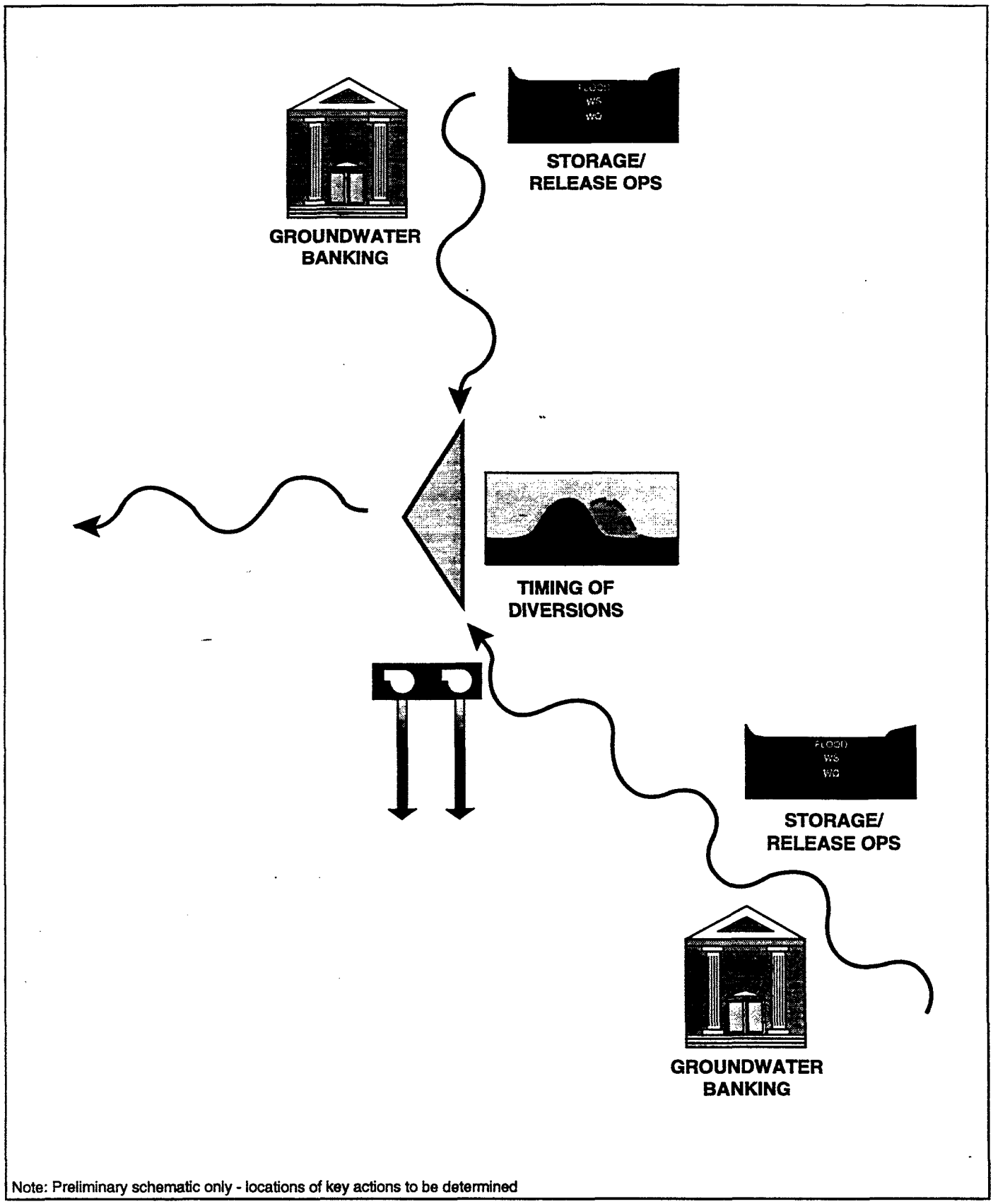
Preliminary Assessment

Ecosystem Quality— This alternative results in an improvement in ecosystem quality through habitat restoration and instream flow management above current levels. Entrainment impacts would be reduced.

Water Supply— This alternative improves Delta and export supply reliability primarily by improving the availability of adequate water quality to meet urban, agricultural, industrial, and ecosystem beneficial use requirements. The alternative may result in a decrease in the availability of supply at certain times if the export diversion requirements cannot be coordinated with water quality needs.

Water Quality— This alternative improves water quality by providing increased flows at times needed to dilute water quality contaminants and reduce salinity levels. Other water quality improvements are achieved by supporting and core actions such as controlling and managing contaminant sources, increasing the supply available for in-stream flows, and reducing the risk of island inundation. Stabilization of levees reduces the risk of a catastrophic event causing degradation in the water quality (e.g. island inundation has the potential to increase salinity levels at diversion locations).

System Vulnerability— The island and levee maintenance and stabilization support action will reduce the vulnerability of the Delta from catastrophic inundation.



Note: Preliminary schematic only - locations of key actions to be determined

726.0610 CALFED 1/96 KEJ

CALFED

WQ-2

IMPROVE DELTA FLOW THROUGH OPERATIONAL MODIFICATIONS

MONTGOMERY WATSON

B—004693

B-004693

Alternative WQ-3

Group
Water Quality

Title
Pollutant Source Control and in-Delta Flow Management Using Added Upstream Storage

Many of the problems in the Delta originate because of poor water quality caused by a combination of agricultural, urban, industrial, and naturally occurring pollutant sources, insufficient flows and circulation patterns that create "reverse flows" and "null" zones, and saltwater intrusion from the ocean into the Delta. Salinity levels are a water quality parameter of concern for agricultural, urban, and industrial Delta water users; suspended solids are of concern to agriculture; and organic carbon and pollutants are of concern to urban users. The theme of this alternative is to provide environmental and water supply benefits through a combination of pollutant source management and improved flow and circulation management within the Delta. Key actions that address this theme include contaminant source control, increased upstream storage capacity, reservoir reoperation, and increased instream flows, to provide releases to meet water quality requirements to meet environmental and water supply needs. Construction of flow and fish barriers and upstream and in-Delta habitat improvements are also included. These key actions will be supplemented with diversion management actions designed to enhance fisheries, conservation, water transfers, conjuctive use, and system reliability improvements, all of which should reduce demands and result in relaxation of current export diversion restrictions.

Water quality and dependent beneficial uses can be enhanced in the Delta by coordinated actions that address the management of pollutant sources and the management of in-Delta flows and water movement. Management of pollutant sources includes actions directed at source reduction and the elimination and treatment of nonpoint source discharges prior to entering the Delta. Pollutant source controls include implementing source control regulations for agricultrual drainage and retiring lands with drainage problems. Treatment controls may include storage and treatment facilities for better management of mine drainage sources. The context for establishing priorities for pollutant source management would be the watershed management approach, whereby priority sources (e.g., mine drainage) would be mitigated through flexible institutional and regulatory arrangements. Pollutant source control is not sufficient to protect resources from adverse water quality impacts unless it is associated with measures to counteract reduced flows and circulation patterns that draw Bay waters into the Delta. In order to better manage this aspect of the water quality problem, increased flows, better management of the timing of flows, and the provision of barriers to better direct these flows are called for in this alternative. Actions that increase upstream storage and provide greater flexibility in the management of that storage are therefore incorporated. This combination of source control, in-Delta flow control, and increased upstream storage also will be managed to improve upstream and in-Delta habitat and water supply reliability. For example, providing pulse flows for fish migration enhancement would be accomodated in this alternative. Water supply reliability should increase as export pumping restrictions are relaxed in response to efficacy of actions providing water quality, habitat, and fisheries enhancement.

Key Actions

Improved Pollutant Source Controls— Existing source control regulations for pollutants may not be sufficiently comprehensive nor enforced to levels required to protect beneficial uses in the Bay-Delta system and tributary rivers. These actions would provide for an array of increased source reduction activities such as additional regulation of agricultural and urban drainage and better enforcement, establishing BMP's for a range of activities affecting Delta water quality such as levee maintenance and pest control practices, and supporting and enhancing existing land retirement and fallowing programs.

Using a watershed management approach, identify and control high priority pollutant sources through a combination of source reduction and treatment actions. Provide regulatory incentives and develop institutional agreements to enable focusing resources on priority sources. Intense application of core level actions such as implementing source control regulations for pollutants, levee maintenance best management practices to encourage use of materials compatible with good water quality, retirement of lands with serious drainage disposal problems, retirement or fallowing agricultural lands with salt or other contaminant drainage problems to reduce land-derived salt contamination, management of irrigation tailwater, retention and management of stormwater runoff, and management of discharges from abandoned mining sites would improve water quality management.

Implement on-site mine drainage remediation measures based on requirements in current regulations. Through changes in water pollution requirements give urban areas flexibility to fund high-priority mine cleanup in lieu of increasing expenditures on treatment plant improvements.

Increase Capacity of Selected Upstream Reservoirs— In order to provide additional storage for in-Delta flow management, raise upstream reservoirs or build additional reservoirs, capacities should be increased so that releases can provide environmental and water supply benefits during normal conditions while maintaining adequate carryover for critical periods.

Increase Downstream Floodway Capacities— Increase downstream channel capacities by widening channels, building setback levees, expanding existing floodways, and/or constructing new floodways to reduce reservoir flood reserve capacity requirements.

Reoperate Existing Upstream Reservoirs— Reevaluate reservoir operations, flood control reserve capacity requirements and other operational constraints, and develop more flexible operating criteria using adaptive management. Utilize additional storage as a source of releases for water quality, fisheries, habitat and water supply reliability.

Construct Flow and Fish Barriers— Construct flow and fish barriers to better manage water movement in the Delta, minimize reverse flows and salinity intrusion, and facilitate fish migration into and from the Delta. Potential fish barrier locations include the Delta Cross Channel, Georgiana Slough, and Threemile Slough. Construct tide gates and/or flow barriers in the southern Delta to better manage south Delta water quality. Operation of the fish barriers will be coordinated with assistance from real time monitoring of anadromous fish population and movement.

Modify Timing of Releases— Using real time monitoring and adaptive management, manage upstream reservoir releases from New Melones, Folsom, and other reservoirs both seasonally and annually to improve Delta water quality through dilution of land- and activity-derived contaminants, and ocean salinity repulsion. Implementation is at a higher level than the core actions reflect. Modify Sacramento and San Joaquin Valley as well as export area reservoir releases and groundwater storage releases in conjunction with upstream operations to accommodate system demands. Focus the timing of releases on water quality improvements while also providing (to a lesser degree of emphasis) instream aquatic habitat benefits such as improved temperature levels and optimal flows.

Bay-Delta Habitat Restoration— Restoration of Bay-Delta habitat would rely on core-level implementation of actions such as protecting existing shallow habitat from erosion, restoring/preserving channel islands, modifying levee maintenance practices, and expansion of wetland acquisition programs.

Upstream Habitat Restoration— The key and supporting actions in this alternative would improve flow and temperature management through increased upstream storage, modified carryover and release criteria, and improved pulse and attraction flows. Restoration of upstream habitats also would rely on core-level implementation of actions such as restoring spawning gravels in high-priority upstream anadromous fish habitats, restoring high-priority sites for riparian vegetation, and improving fish passage at high-priority barriers.

Supporting Actions

Reduction in Diversion Effects— Diversion effects would be lessened by core-level implementation of actions such as use of real-time monitoring and adaptive management, installation of fish screens upstream of and in the Delta, enforcement of screening requirements, and improved operation of salvage and hauling and release procedures.

Management of Fisheries Production and Take— Core-level implementation of actions including improved hatchery operations, reduced hatchery effects on wild fish populations, improved regulation of recreational and commercial take, and improved enforcement of harvest regulations would be part of this alternative.

Reduce Water Demand on Delta and Increase In-Stream Flows— Use a variety of actions involving increased agricultural, municipal, and industrial conservation and reclamation; acquisition of supplemental water; and expanded use of desalination with the intent of reallocating the additional water supplies for use as instream dilution flows. Conservation strategies would include encouraging land fallowing and water pricing measures. The freed-up supplies would then be available to provide water quality protection through dilution and habitat improvements such as improved temperature and pulse flows during critical migration periods.

Water Transfers and Conjunctive Use— The key actions included in this alternative improve water supply predictability. Additionally, core-level implementation of actions including improved procedures for transfer permitting, particularly during drought years, coordinating diversion and conveyance of transfers, conducting integrated resources planning, establishing long-term guarantees for water management, coordination of

groundwater/surface water management, and coordination of land use actions with water supply needs would enhance predictability during critical periods.

Levee and Channel Improvements— Implement core actions at a minimum level to improve system reliability through channel improvements and levee maintenance and stabilization by modifying agricultural practices to reduce subsidence, providing funding for maintenance and stabilization, and maintaining or reconstructing levees around infrastructure. These actions would reduce the risk to the water supply, water quality, ecosystem quality, and existing land uses and infrastructure of the Bay-Delta system. Levee improvements would focus on levee dimensions (including height above the maximum flood water surface elevation) and the creation of stabilizing berms. These berms would be constructed on the landside or waterside. Waterside berms would be constructed solely to enhance aquatic habitat, but only if they do not interfere with conveyance of adjacent channels. Actions to control subsidence adjacent to the levees could include modifying agricultural practices adjacent to levees or creating landside habitat. Channel maintenance would improve conveyance of flood flows through the Delta and could include efforts to restore aquatic habitats in combination with waterside berms where current habitat is inadequate.

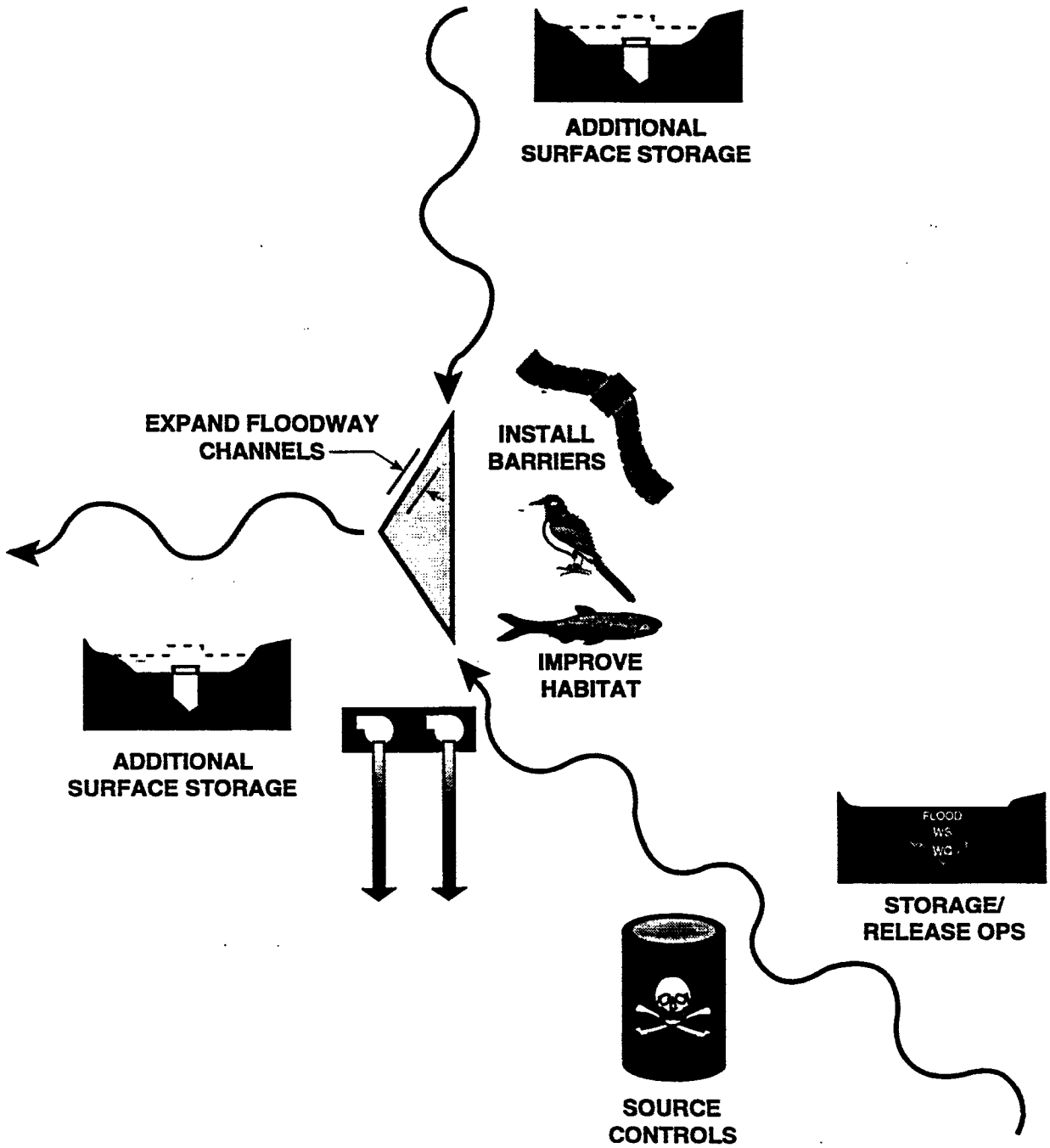
Preliminary Assessment

Ecosystem Quality— The key and supporting actions included in this alternative result in an overall increase in potential to manage upstream reservoir storage/outflow, upstream and in-Delta habitat, and diversions to enhance ecosystem quality.

Water Supply— Available water supply is significantly increased through additional upstream storage and reoperation of existing reservoirs to increase overall system yield. Benefits to export areas may be limited by lack of export area storage and also will depend on whether key actions improve fisheries to a sufficient degree that current export pumping restrictions can be relaxed.

Water Quality— Significant water quality benefits should be realized from this alternative through combined pollutant source management and in-Delta flow management.

System Reliability— System reliability would be significantly increased through additional upstream storage and implementation of levee enhancement measures above the core-level.



Note: Preliminary schematic only - locations of key actions to be determined

726.0610 CALFED 1/96 KEJ

CALFED

WQ-3

ADDITIONAL STORAGE AND POLLUTANT SOURCE CONTROLS

MONTGOMERY WATSON

B—004698

B-004698

Alternative WQ-4

Group
Water Quality

Title
Chain-of-Lakes Isolated Facility

Many of the problems in the Delta originate because of poor water quality caused by a combination of agricultural, urban, industrial, and naturally occurring pollutant sources, insufficient flows and circulation patterns that create "reverse flows" and "null" zones, and saltwater intrusion from the ocean into the Delta. Salinity levels are a water quality parameter of concern for agricultural, urban, and industrial Delta water users; suspended solids are of concern to agriculture; and organic carbon and pollutants are of concern to urban users. The theme of this alternative is to enhance in-Delta and service area water quality, primarily by modifying and constructing in-Delta physical facilities, while minimizing adverse impacts, but allowing the conversion of some existing land uses. The key elements of this approach include the conversion of selected low-elevation islands along a north-south axis between the Sacramento River and the project export pumps from their present uses (predominantly for agriculture) into storage reservoirs connected by a series of inverted siphons beneath Delta channels, diversion of good quality water from the Sacramento River through a single, or multiple, screened intake structure(s) into the first island reservoir(s), sequential siphoning of diverted water through the island reservoirs to the export pumps, and releases of diverted water to selected Delta channels to improve water quality and meet in-Delta environmental and economic needs.

This alternative can be optimized when used in conjunction with improved upstream and export area reservoir storage capacities. The improved point(s) of diversion allow more water of higher quality to be diverted (from upstream releases from storage and in-channel flows) at times of the year (generally the early winter months) when impacts on fish and other aquatic organisms are least, stored temporarily in the Delta island reservoirs, and then exported to downstream reservoirs and service areas. Accumulation of natural organic material in the water supply should be minimized through the use of impervious barriers, such as clay sealant layers, placed over the peat soils. Use of the island reservoirs for ecological restoration would need to be balanced with the need to avoid contamination of the water supply.

A possible major variation of this alternative would utilize only selected western Delta islands for storage, siphon diverted water under the San Joaquin River, make releases into adjacent channels for salinity control and entrapment zone maintenance, and make releases for export in the vicinity of Franks Tract or further south, enlarge the South Delta channels leading to the export pumps, maintain sufficient hydraulic gradients to create bypass flows past new export fish screens, and maintain adequate downstream San Joaquin River flows to improve instream habitat and transport fish and improve central Delta water quality. This variation has not developed any further at this time because it would generate major impacts and would require additional feasibility tests.

Key Actions

Construction and Improvement of Conveyance Facilities— Convert selected Delta islands into an interconnected storage and conveyance system (the "chain-of-lakes concept") extending from a northern diversion or diversions, located on the Sacramento River (between Hood and Rio Vista), to the project export pumps. Flood and/or dike the islands/tracts (potentially all or some of Grand, Brannan-Andrus, Tyler, Staten, Twitchell, Bouldin, Bradford, Webb, Venice, Mandeville, Medford, McDonald, Holland, Bacon, Palm, Orwood, Woodward and Victoria Islands; and Pierson, Byron, and Franks Tracts) and connect them with a sequence of single or multiple inverted siphons installed beneath the intervening channels. Add pump stations at selected locations as necessary to generate the additional pump lift needed (cumulatively up to 3 feet) to optimize island water storage capacities and deliver water at the surface water elevation of an enlarged Clifton Court Forebay ~~redesigned to serve the SWP, and optionally, the CVP?~~ Consider relocating the Contra Costa Canal intake to the Forebay.

Reduce Effects of Diversions— Reduce effects on Bay-Delta aquatic habitat quantity and quality by relocating and reducing in-Delta and export diversions, altering their timing, and improving or constructing fish screens. The major benefit is achieved by relocating one or both of the export diversions from their current South-Delta sites, which presently induce converging channel flows and flow reversals (periodically of relatively poor quality water containing both ocean- and land-derived salts) directly toward the pumps. Relocation would be to the Sacramento River, where water quality is much better due to the larger quantities of diluting inflows and reduced impacts of land uses. Also, diversion timing and duration constraints are much reduced at the Sacramento River location (diversions can be better-timed to avoid fish migration periods and beneficial downstream bypass flows can be maintained past optimally-designed fish screens). Removal of these constraints will eliminate or greatly reduce the diversion of poor quality water into the export system from locations and during periods of sub-optimal water quality.

Modify facilities and/or operations to vary remaining Delta channel flows, particularly the flow split between the Sacramento and Mokelumne systems, flows toward areas of pumpage to serve in-Delta uses, and inflows into Old River, Middle river, and the San Joaquin River for the purposes of diluting contaminants, and displacing or flushing waters of poor quality (as well as avoiding entrainment and improving aquatic habitat). Modify Delta and export diversions and increase export capacities in order to shift the seasons of diversion to reciprocally improve capabilities to reduce diversions at other times when and where higher instream flows are needed to meet water quality (and biological requirements). Achieve equity by permitting higher diversion and export rates when the flows are not needed for dilution.

Provide Island Releases— Improve in-Delta water quality (especially total dissolved solids) where and when possible by utilizing the higher quality Sacramento River water (or in-Delta island reservoir water blends) to make releases from the flooded islands into Delta channels at selected locations adjacent to the project. Releases (through siphons or pumps) could be made to rapidly respond to water quality degradation in the Delta (e.g. from saltwater intrusion or agricultural drainage discharges) at times when there would be no interference with anadromous fish migrations. South Delta water quality could be significantly improved by such releases made in combination with the minimum numbers and sizes of local tide gates, barriers and salinity control structures (such as sills or weirs) needed to optimize the distribution of local flows and flushing of contaminants. Island reservoir water quality could be protected from degradation by the leaching of organic materials through the use of suitable lining materials or layers, or the removal of peat soils.

Island and Levee Maintenance and Stabilization— Reconstruct and protect selected high-value levees and those surrounding the island transfer system (on both the inside and outside) to eliminate or reduce erosion, seepage, overtopping, and the risk of seismically-induced failures. Use levee setbacks and berms wherever feasible and needed for improved stability, and consider the use of permeable, large-rock levees that permit hydraulic continuity between the interior reservoirs and external channels (use of the latter would eliminate the need for fish screens and discharge facilities, at the expense of creating fouling potential and loss of control over interior water surface elevations, releases, and inflows) . Stabilize other islands with smaller scale levee improvements or large scale in-filling of the lowest areas with suitable blends of inorganic soil and compost, or clean dredged materials, to restore interior elevations to near mean sea level.

Supporting Actions

New Shallow Water Habitat Areas— Create new shallow water habitat by converting selected fringe areas, especially on the outside of the island reservoirs, into wetlands, and suitable channel-side slopes into berms supporting tidal wetlands. Plant emergent aquatic vegetation to enhance natural filtration, uptake, and absorption of contaminants from both the reservoirs and channels while minimizing the potential for increasing natural organic material in the export water supply.

Timing of Releases— Utilize existing upstream evaporation ponds for the temporary storage of agricultural drainage and make discharges to the rivers only during floods or other periods of adequately-high instream diluting flows. Apply similar timing measures where they apply to reducing water quality impacts resulting from other types of discharges.

Increasing Water Supply Predictability— Existing and/or new upstream and downstream reservoir storage capacity is expanded, facilities and operations are modified to increase groundwater storage and conjunctive use, export diversion capacity is increased, and other supporting measures are undertaken to maximize the flexibility of diversion and export timing. These measures can also help provide additional flood protection. South Delta water stages, pumping capabilities, and consequent supply reliability are improved in that area by the tide stage and flow control facilities.

Improve Pollutant Source Controls— Existing source control regulations for pollutants may not be sufficiently comprehensive nor enforced to levels required to protect beneficial uses in the Bay-Delta system and tributary rivers. These actions would provide for an array of increased source reduction activities such as additional regulation of agricultural and urban drainage and better enforcement, establishing BMP's for a range of activities affecting Delta water quality such as levee maintenance and pest control practices, and supporting and enhancing existing land retirement and fallowing programs.

Using a watershed management approach, identify and control high priority pollutant sources through a combination of source reduction and treatment actions. Provide regulatory incentives and develop institutional agreements to enable focusing resources on priority sources. Intense application of core level actions such as implementing source control regulations for pollutants, retirement of lands with serious drainage disposal problems, retirement or fallowing agricultural lands with salt or other contaminant drainage problems to reduce land-derived salt contamination, management of irrigation tailwater, retention and management of stormwater runoff, and management of discharges from abandoned mining sites would improve water quality management.

Implement on-site mine drainage remediation measures based on requirements in current regulations. Through changes in water pollution requirements give urban areas flexibility to fund high-priority mine cleanup in lieu of increasing expenditures on treatment plant improvements.

Reduce Water Demand on Delta and Increase In-Stream Flows— Use a variety of actions involving increased agricultural, municipal, and industrial conservation and reclamation; acquisition of supplemental water; and expanded use of desalination with the intent of reallocating the freed-up water supplies for use as in-stream dilution flows and to reduce salinity levels. Conservation strategies would include encouraging land fallowing and water pricing measures. The freed-up supplies would then be available to provide water quality protection through dilution and habitat improvements such as improved temperature and pulse flows during critical migration periods.

Water Transfers— Water transfer core actions can be timed and maximized so that the increased flows in upstream channels and the Delta dilute contaminants of concern. The

overall improvement in the quality of diverted and delivered water supplies is a significant benefit.

Core Actions

This alternative assumes implementation of the remaining core measures at the minimum selected levels.

Preliminary Assessment

Equity actions would be included to reduce or eliminate impacts where possible, however in-Delta losses of economic land uses could only be mitigated by payments or land trades. Increased storage (including in-Delta) and reclamation will augment service area supplies and improved integrated resources management (especially backup local storage and conjunctive use) will make alternate supplies available. The overall improvement in the quality of diverted and delivered water supplies is in itself a benefit that helps to achieve equity. Over time, the volume and salt load in agricultural drainage will be greatly reduced due to the improved quality of applied irrigation water and irrigation efficiency. A "Chain-of-Lakes" system is more vulnerable to failure than an Eastside Isolated Delta Facility located on stable soils, but a major improvement over the existing system.

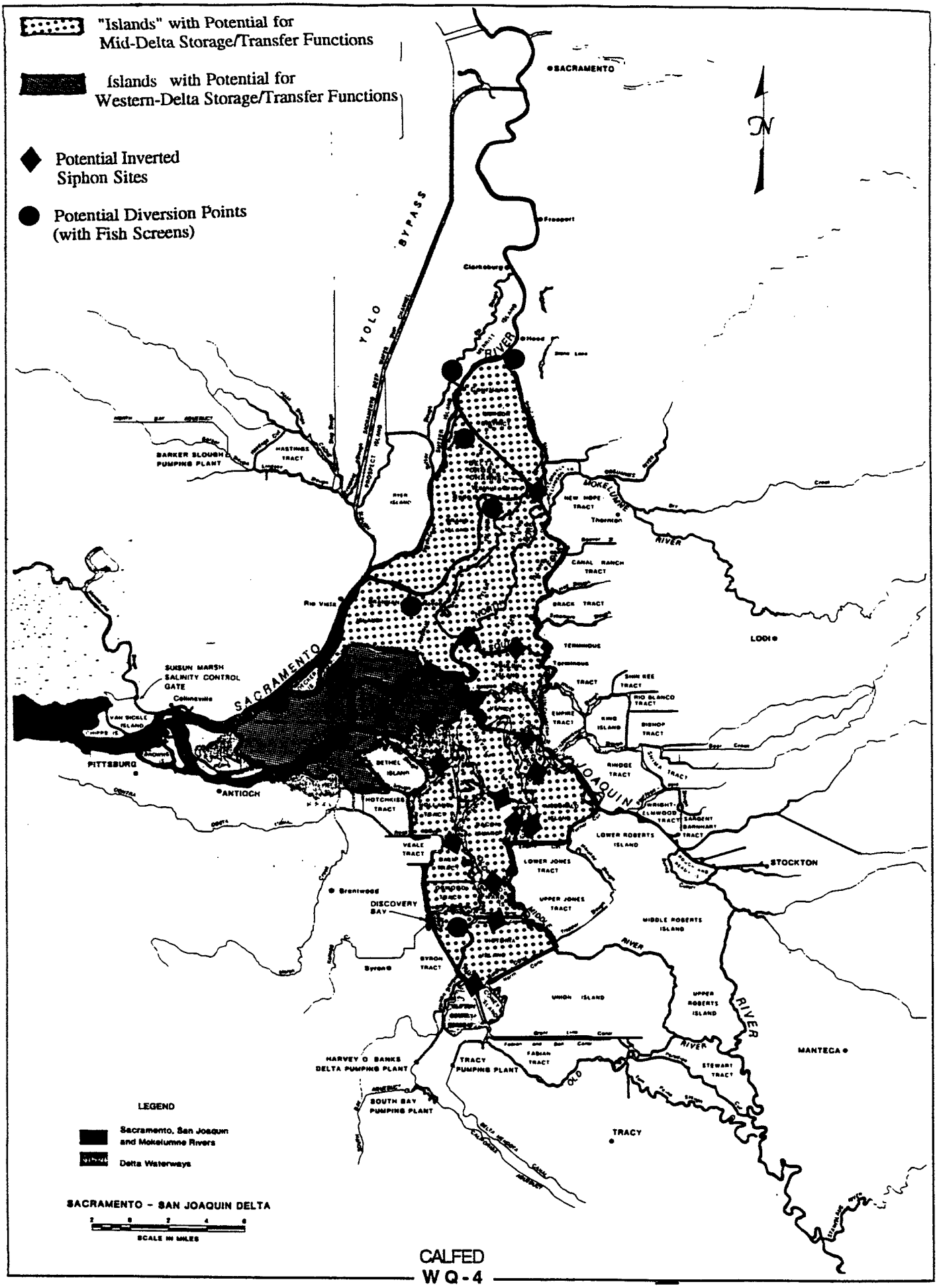
Ecosystem Quality— Ecosystem quality would be greatly improved by actions and core measures that create and enhance habitat. Modification of export diversion locations and increasing export capacity coupled with the capability to make in-Delta releases of Sacramento River water or blends, provide capabilities to release Delta channel flows when needed to maintain water quality requirements for in-Delta uses and aquatic biota. The major benefit is achieved by relocating the export diversion from the current South-Delta location to the Sacramento River, where diversions can be better-timed to avoid fish migration periods and bypass flows can be maintained past new fish screens.

Water Supply— Supply predictability is greatly improved with this alternative because threatened and endangered species constraints on exports will be far less in magnitude and frequency. Increased storage and reclamation will augment service area supplies and improved integrated resources management (especially backup local storage and conjunctive use) will make alternate supplies available when needed.

Water Quality— This alternative would improve in-Delta and export water quality for ecological and service area needs by increasing the quantity and quality of water available in the Delta and changing the timing of diversions to avoid periods of poorer water quality. Although beneficial, Delta channel releases for water quality improvement

would not be as effective as from an East Delta Isolated facility due to the lack of flushing of the upstream channel segments and the probability of contaminants being leached from the island soils (unless successfully mitigated). Quantities of contaminants entering the aquatic system from upstream are also reduced, however some contaminants and disinfection byproduct precursors (particularly THM precursors) derived from Delta waters and soils could enter the drinking water supply and cause higher treatment costs and/or risks. Overall in-Delta and export mineral water quality is improved by direct access to, and releases of, higher quality Sacramento River water. Core actions are maximized to further improve water quantity and quality in Bay-Delta receiving and exported waters, and improve habitats. Specifically, the actions would 1) serve to increase the quality and quantity of water available in the Delta thereby decreasing the concentrations of contaminants; 2) alter the distribution and timing of flows in the Delta making more water available in the system for dilution of contaminants and beneficial use; and 3) change the locations and timing of diversions to avoid periods of poor water quality. This affords more flexibility than at present to properly time and manage Delta inflows and exports to improve water quality for ecosystem and export needs.

System Reliability— The upgraded levees will greatly reduce flood overtopping and levee failure risks and associated water quality degradation potential. The probability of a prolonged shutdown of the water projects and local diversions will be greatly reduced. Implementation of the island in-filling process will allow remaining agricultural, recreational and associated land uses to continue, while relieving a significant amount of hydrostatic pressure on the levee system. Maximum core levee maintenance actions will provide additional protection against flood- and seismically-induced levee failures, and reduce future risks of system-failure or water quality-induced shutdowns and export curtailments.



CALFED

WQ-4

IMPROVE EXPORT WATER QUALITY AND IN-DELTA FLOW AND WATER QUALITY MANAGEMENT USING CHAIN-OF-LAKES ISOLATED FACILITY

B—004705

Alternative WQ-5

Group
Water Quality

Title
Eastside Delta Isolated Facility

Many of the problems in the Delta originate because of poor water quality caused by a combination of agricultural, urban, industrial, and mining pollutant sources, insufficient flows and circulation patterns that create "reverse flows" and "null" zones, and saltwater intrusion from the ocean into the Delta. Salinity levels are a water quality parameter of concern for agricultural, urban, and industrial Delta water users; suspended solids are of concern to agriculture; and organic carbon and pollutants are of concern to urban users. The thematic objective of this alternative is to enhance in-Delta and service area water quality, primarily by constructing an East Delta Isolated Conveyance Canal and appurtenant physical facilities, while minimizing adverse impacts and changes in existing land uses. The key element of this approach is excavation of an isolated canal on the stable mineral soils around the eastern and south-eastern edges of the Delta to serve the SWP or combined SWP/CVP. The canal could be of either small, medium or large capacity. Releases from the Canal to Delta channels would be an optional feature requiring enlarged intake size, channel capacity, and release structures. The canal segments would be connected by a series of inverted siphons beneath points of significant Delta inflows with pump stations located where additional head is needed. Good quality water would be diverted from the Sacramento River through a single, or multiple, screened intake structure(s) into the canal. From here it would be siphoned sequentially through each of the canal segments to the export pumps. Releases could be made to Delta channels to improve water quality and meet in-Delta environmental and economic needs as long as the releases do not impair or deviate anadromous fish migrations.

This alternative could be optimized if used in conjunction with improved upstream and export area reservoir storage capacities. The improved point(s) of diversion allow more water of higher quality to be diverted (from upstream releases from storage and in-channel flows) at times of the year (generally the early winter months) when impacts on fish and other aquatic organisms are least, stored briefly in Clifton Court Forebay or other optional Delta island reservoirs, and then exported to export area reservoirs and service areas. Sources of water quality degradation south of Hood (including agicultural drainage and peat soil leachates) are kept out of the export system. Delta channel releases to compensate for Sacramento River diversions and improve in-Delta water quality, especially in dead-end sloughs and areas of stagnation or concentration of salts such as south Delta channels, could be optimized from an East Delta Isolated facility.

Key Actions

Construction and Improvement of Conveyance Facilities— The key elements of this approach involve the construction of a small, medium or large capacity canal on the stable mineral soils around the eastern and south-eastern edges of the Delta to serve the SWP or combined SWP/CVP. Canal releases to Delta channels would be an optional feature requiring enlarged intake size and channel capacity (up to 20,000 cfs). The canal segments would be connected by a series of inverted siphons beneath creek and river channels (potentially the Mokelumne River, Bear Creek, San Joaquin River, Old River, and Middle River) with pump stations located where additional head generation is needed. Good quality water would be diverted from the Sacramento River through a single, or multiple, screened intake structure(s) into the canal. From here it would be siphoned sequentially through the canal segments to the export pumps. Releases would be made to Delta channels to improve water quality and meet in-Delta environmental and economic needs as long as the releases do not impair anadromous fish migrations. Release points would require screening unless suitable upstream fish passage facilities can be designed at the Sacramento River diversion and other needed sites. Include a pump station or stations at selected locations as necessary to generate the additional pump lift needed (cumulatively up to 3 feet) to optimize the canal gradient and deliver water at the optimal surface water elevation. Construction of an enlarged Clifton Court Forebay (or multiple in-Delta storage reservoirs) to serve the SWP, (or both the CVP and SWP) is optional. Consider relocating the Contra Costa Canal intake to the Forebay.

Reduce Effects of Diversions— Reduce effects on Bay-Delta aquatic habitat quantity and quality by relocating and reducing in-Delta and export diversions, altering their timing, and improving or constructing fish screens. The major benefit is achieved by relocating the export diversions from their current South-Delta sites, which presently induce converging channel flows and flow reversals (periodically of relatively poor quality water containing both ocean- and land-derived salts) directly toward the pumps, to the Sacramento River, where water quality is much better due to the larger quantities of diluting inflows and reduced impacts of land uses. Also, diversion timing and duration constraints are much reduced at the Sacramento River location (diversions can be better-timed to avoid fish migration periods and beneficial downstream bypass flows can be maintained past optimally-designed fish screens). Removal of these constraints will also eliminate the induction of poor mineral quality water and reduce the influx of other contaminants into the export system during periods of sub-optimal water quality. Modify facilities and/or operations to vary remaining Delta channel flows, particularly the flow split between the Sacramento and Mokelumne systems, flows toward areas of pumpage to serve in-Delta uses, and inflows into the San Joaquin, Old, and Middle Rivers, for the purposes of diluting contaminants, and displacing or flushing waters of poor quality (as well as avoiding entrainment and improving aquatic habitat). Modify Delta and export diversions and increase export capacities in order to shift the seasons of diversion to reciprocally improve capabilities to reduce diversions at other times when and where

higher instream flows are needed to meet water quality (and biological requirements). Achieve equity by permitting higher diversion and export rates when the flows are not needed for dilution.

Provide Canal Releases— Improve in-Delta water quality where and when possible by utilizing the higher quality Sacramento River water (or resultant water blends) to make releases from the canal into Delta channels at selected locations around the periphery of the Delta, adjacent to the project. Releases could be made to rapidly respond to water quality degradation in the Delta (e.g. from saltwater intrusion or agricultural drainage discharges) at times when there would be no interference with anadromous fish migrations. South Delta salinity could be greatly improved by such releases, especially if operated in conjunction with the minimum numbers and sizes of local tide gates, barriers and salinity control structures (such as sills or weirs) needed to optimize the distribution of local flows and flushing of contaminants.

Supporting Actions

Island and Levee Maintenance and Stabilization— Reconstruct and protect selected high-value levees to eliminate or reduce erosion, seepage, overtopping, and the risk of seismically-induced failures. Use levee setbacks and berms wherever feasible and needed for improved stability. Stabilize other islands with smaller scale levee improvements or large scale in-filling of the lowest areas with suitable blends of inorganic soil and compost, or clean dredged materials, to restore interior elevations to near mean sea level. These measures would also serve to protect against water quality effects associated with catastrophic levee failures.

New shallow water habitat areas— Create new shallow water habitat by converting selected fringe areas of the canal and island reservoirs/forebays into wetlands, and suitable channel-side slopes into berms supporting tidal wetlands. Plant emergent aquatic vegetation to enhance natural filtration, uptake, and absorption of contaminants from both the reservoirs and channels.

Timing of Releases— Utilize existing upstream evaporation ponds for the temporary storage of agricultural drainage and make discharges to the rivers only during floods or other periods of adequately-high instream diluting flows. Apply similar timing measures where they apply to reducing water quality impacts resulting from other types of discharges.

Increasing Water Supply Predictability— Existing and/or new upstream and downstream reservoir storage capacity is expanded, facilities and operations are modified to increase groundwater storage and conjunctive use, export diversion capacity is increased, and other supporting measures are undertaken to maximize the flexibility of diversion and export timing. These measures can also help provide additional flood protection. South Delta water stages, pumping capabilities, and consequent supply reliability are improved in that area by the canal releases and any supplemental flow and stage control facilities that may prove necessary.

Improve Pollutant Source Controls— Existing source control regulations for pollutants may not be sufficiently comprehensive nor enforced to levels required to protect beneficial uses in the Bay-Delta system and tributary rivers. These actions would provide for an array of increased source reduction activities such as additional regulation of agricultural and urban drainage and better enforcement, establishing BMP's for a range of activities affecting Delta water quality such as levee maintenance and pest control practices, and supporting and enhancing existing land retirement and fallowing programs.

Using a watershed management approach, identify and control high priority pollutant sources through a combination of source reduction and treatment actions. Provide regulatory incentives and develop institutional agreements to enable focusing resources on priority sources. Intense application of core level actions such as implementing source control regulations for pollutants, retirement of lands with serious drainage disposal problems, retirement or fallowing agricultural lands with salt or other contaminant drainage problems to reduce land-derived salt contamination, management of irrigation tailwater, retention and management of stormwater runoff, and management of discharges from abandoned mining sites would improve water quality management.

Implement on-site mine drainage remediation measures based on requirements in current regulations. Through changes in water pollution requirements give urban areas flexibility to fund high-priority mine cleanup in lieu of increasing expenditures on treatment plant improvements.

Reduce Water Demand on Delta and Increase In-Stream Flows— Use a variety of actions involving increased agricultural, municipal, and industrial conservation and reclamation; acquisition of supplemental water; and expanded use of desalination with the intent of relocating the freed water supplies for use as in-stream dilution flows and to reduce salinity levels. Conservation strategies would include encouraging land fallowing and water pricing measures. The freed up supplies would then be available to provide water quality protection through dilution and habitat improvements such as improved temperature and pulse flows during critical migration periods.

Water Transfers— Water transfer core actions can be timed and maximized so that the increased flows in upstream channels and the Delta dilute contaminants of concern. The overall improvement in the quality of diverted and delivered water supplies is a significant benefit.

Core Actions

This alternative assumes implementation of the remaining core measures at their minimum levels.

Preliminary Assessment

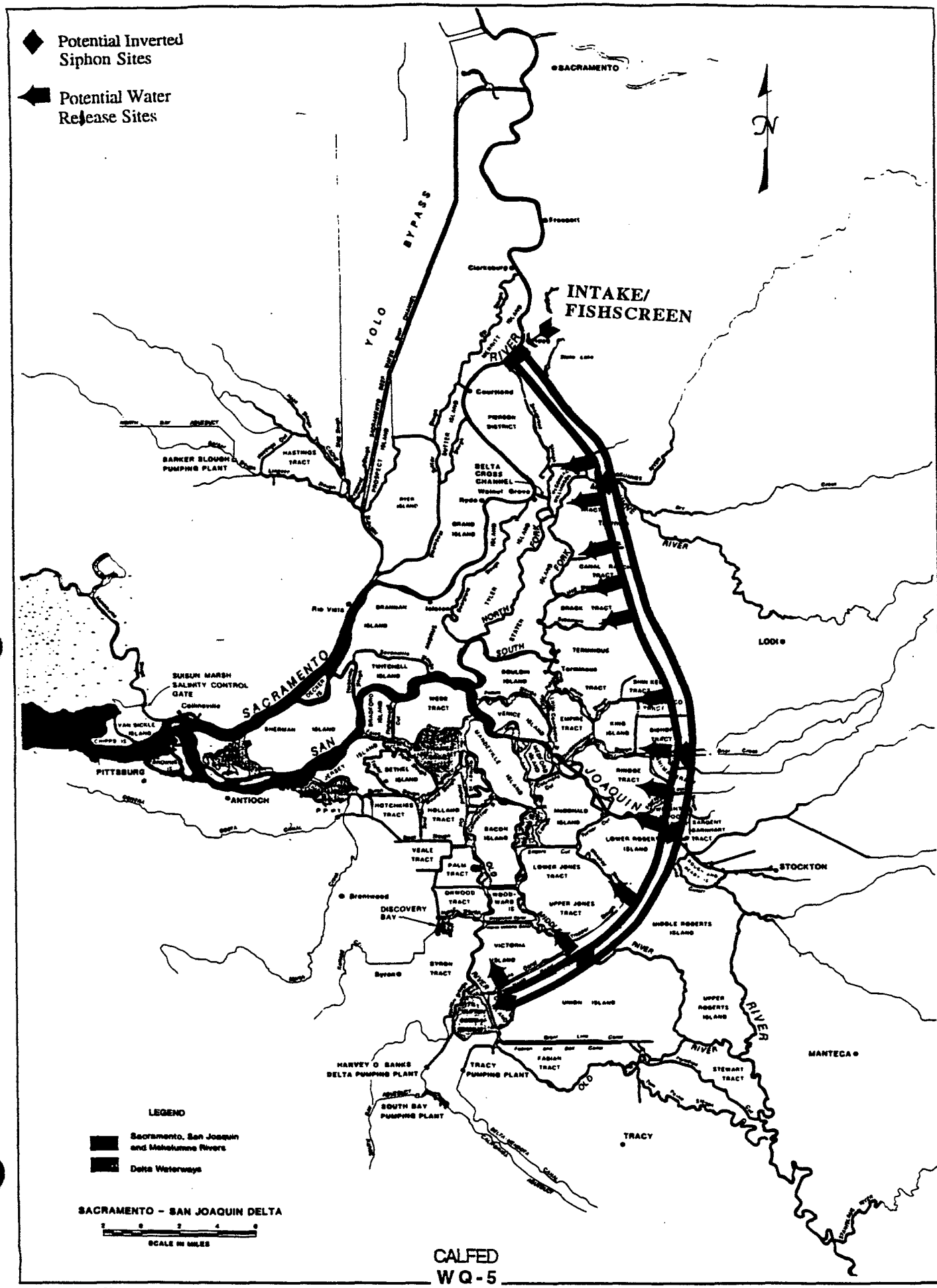
Ecosystem Quality— The major benefit is achieved by relocating the export diversion from the current South-Delta location to the Sacramento River, where diversions can be better-timed to avoid fish migration periods and bypass flows can be maintained past new fish screens. This alternative would improve in-Delta and export water quality for ecological and service area needs by increasing the quantity and quality of water available in the Delta and changing the timing of diversions to avoid periods of poorer water quality. Modification of export diversion location and increasing export capacity coupled with the capability to make in-Delta releases of Sacramento River water (when there would be no interference with anadromous fish migrations) provide capabilities to release Delta channel flows when needed to maintain water quality requirements for in-Delta uses and aquatic biota. The attractive flow and upstream fish passage problems at the points of release and diversion would need to be solved.

Water Supply— Supply predictability is greatly improved with this alternative because there will be virtually no threat of interruption due to Delta levee failures, and threatened and endangered species constraints on exports will be far less in magnitude and frequency. Increased storage and reclamation will augment service area supplies and improved integrated resources management (especially backup local storage and conjunctive use) will make alternate supplies available when needed.

Water Quality— Modification of export diversion location and increasing export capacity coupled with the capability to make peripheral Delta releases of Sacramento River water (or blends), provide capabilities to release Delta channel flows where and when needed to maintain water quality requirements for in-Delta uses and aquatic biota. This alternative would improve in-Delta and export water quality for ecological and service area needs by increasing the quantity and quality of water available in the Delta and changing the timing of diversions to avoid periods of poorer water quality. Quantities of contaminants entering the aquatic system from upstream are also reduced. Overall in-Delta and export water quality is improved by direct access to, and releases of, higher quality Sacramento

River water. Eastside releases would be very effective in flushing contaminants and freshening stagnant channel reaches. Over time, the volume of and salt load in agricultural drainage will be greatly reduced due to the improved quality of irrigation water. Core actions to further improve water quantity and quality in Bay-Delta receiving and exported waters, and improve habitats. Specifically, the actions would 1) serve to increase the quality and quantity of water available in the Delta thereby decreasing the concentrations of contaminants; 2) alter the distribution and timing of flows in the Delta making more water available in the system for dilution of contaminants and beneficial use; and 3) change the locations and timing of diversions to avoid periods of poor water quality and reduce entrainment of high fish populations. This affords flexibility to manage Delta inflows and exports to improve water quality for ecosystem and export needs.

System Reliability— The probability of a prolonged shutdown of the water projects and local diversions will be greatly reduced. Implementation of selected island in-filling will allow remaining agricultural, recreational and associated land uses to continue, while relieving a significant amount of hydrostatic pressure on the levee system. Maximum core levee maintenance actions will provide additional protection against flood- and seismically-induced levee failures, and reduce future risks of system-failure-induced shutdowns and export curtailments. Adequate measures will need to be included to pass peak flood flows from points south and east of the Delta, so that local flood control problems are reduced.



CALFED

WQ-5

IMPROVE EXPORT WATER QUALITY AND IN-DELTA FLOW MANAGEMENT/ WATER QUALITY USING EASTSIDE DELTA ISOLATED FACILITY

B—004712

B-004712

Vulnerability

B-004713

Alternative SV-1 **Minimum Protection Level of Delta Islands and System Functions**

The action categories provided in this alternative address three areas of concern. First, the level of flood protection afforded to Delta islands is improved beyond current conditions. Second, habitat restoration actions are provided to appropriately recognize and address the need to balance flood protection actions and expenditures with corresponding habitat improvement actions and expenditures, since the achievement of flood protection benefits may result in the removal or degradation of aquatic and terrestrial habitat. Third, other actions have been added to provide a measure of equitability with respect to providing water quality, levee, fisheries improvements, and water demand reduction/supply enhancements so that this alternative's implementation addresses as many stakeholders as reasonably possible while preserving the land use/flood control/habitat theme of maintaining the physical configuration of the Delta to continue the beneficial functions provided.

Formulation of this alternative began with preliminary alternative WS-1, Demand Reduction. WS-1 was selected as a base alternative because its key and supporting actions provide a strong foundation as a "minimal" approach to addressing several Delta issues directly related to flood protection and habitat protection and restoration. The preliminary assessment of WS-1 suggests the following weaknesses with respect to user groups and other beneficial uses:

1. Slightly greater than minimum ecosystem quality improvements are achieved;
2. Only minimum improvements in water quality are achieved; and
3. Only minimum decreases in system vulnerability are achieved.

Preliminary alternative WQ-128, Managing Discharges, Restoring Existing and Creating New Habitat, provides several water quality and habitat benefits to compensate for these weaknesses, as follows:

1. Habitat restoration actions significantly improve ecosystem quality;
2. Wastewater reclamation and treatment significantly improve water quality; and
3. Levee upgrades reduce the risk of catastrophic failure of Delta facilities;

In addition, the action to modify reservoir operations was added to utilize potentially available storage space for flood control benefits.

Combining WS-1, WQ-128, and modified reservoir operations results in the following alternative SV-1, Minimum Protection Level of Delta Islands and System Functions, which promotes a minimum level of protection necessary to protect Delta functions (including land use, Delta water quality and supply, export water quality and supply, and Delta ecosystem functions)

from catastrophic failure.

Remaining Weaknesses of This Alternative

Ecosystem quality improvements do not include actions to reduce the impacts of diversions (e.g. fish screening) on anadromous and resident fishes, and only minimal upland habitat improvements are recommended. No integrated habitat management strategies, upstream habitat improvements, fish hatchery or harvest operations improvements are included.

Water supply actions do not include on-stream storage expansions or new construction, or the relocation and/or consolidation of diversions. Institutional actions and the establishment of an export capacity market are implemented only at the core level.

The management of agricultural and urban/industrial drainage is only addressed at a minimal level through supporting actions. Dredging and dredge material management is minimally addressed, since this option attempts to integrate channel capacity improvements with natural flood protection measures and increased habitat extent and connectivity. The minimal level of implementation of this alternative provides correspondingly limited opportunities for meaningful linkages or integration of actions which, if implemented at higher levels, could create synergistic benefits, especially with respect to the achievement of concurrent flood protection and habitat improvements.

Alternative SV-1

Group
Land Use/Flood Control/Habitat

Title
Minimum Protection Level of Delta Islands and System Functions

This alternative combines key levee and channel improvements, conservation, reclamation, habitat restoration, and flow barriers to achieve minimal reductions in system vulnerability, noticeable improvements in Delta aquatic and terrestrial habitat, and equitable water supply flexibility. Those actions are supported by water transfers, incentives for more groundwater banking and conjunctive use of surface and groundwater, land retirement and fallowing, and alternative supply development over all regions dependent on Delta waters to ensure that related burdens associated with conservation, reclamation and other actions leading to higher water costs than now incurred are unilaterally shared. It also includes actions to modify reservoir operations.

The vulnerability of Delta functions (including land use, Delta water quality and supply, export water quality and supply, and Delta ecosystem functions) to catastrophic failure is reduced by providing a minimum level of flood protection to all Delta islands. This alternative integrates the linkage between flood control and Delta functions such as Delta water supply and habitat protection. It also enhances opportunities for protection and enhancement of habitat elements that have been modified and are currently inadequate.

Improving levee maintenance and stabilization for all Delta levees (such as Project and Non-Project) to provide a level of flood protection equivalent to the hazard mitigation plan (HMP) standard will reduce the vulnerability of Delta functions to catastrophic failure.

Efforts to reduce the vulnerability around the critical western islands (such as Sherman and Jersey islands) with infrastructure (the Mokelumne Aqueduct, Transmission Lines, Highway 160, etc.) would include actions to provide a level of flood protection equivalent to the Public Law (PL 99) standard. Efforts to reduce the vulnerability of Delta islands with farmland and infrastructure (such as New Hope Tract, Bouldin Island, Sherman Island, Palm Tract, Lower and Upper Jones Tracts, and Lower Roberts Island) would also include actions to improve flood protection to the level provided by Public Law 99. In addition, subsidence potential for some Delta islands with deep peat soils (such as parts of Grand Island, Twitchell Island, Sherman Island, Andrus Island, and Bouldin Island) would be reduced by establishing a landside buffer adjacent to island levees between 25 and 50 yards in width. Implementation of these actions will minimally improve protection of those islands as well as protecting in-Delta and export water supplies from salinity intrusion due to island failure. In addition, an emergency levee management plan to reclaim Delta islands in the event of inundation is necessary to continue protection of Delta functions as an integrated resource system is recommended.

Land retirement and fallowing in the Delta, accompanied by active management of such retired lands for wildlife (e.g. seasonal wetlands) could provide areas for habitat restoration and could contribute to improved water quality. Land retirement and fallowing in the Sacramento and/or San Joaquin Valleys, or in other marginally productive areas dependent on Delta waters could lead to overall improvements in Delta water quality by reducing the

areal extent of agricultural lands (and applied agricultural chemicals) contributing nonpoint and point discharges resulting from irrigation.

Improvements in Delta water quality are also achieved through agricultural, industrial, and municipal wastewater reclamation and reuse (recycled water). The use of recycled water indirectly improves overall system water quality by meeting demands of those users requiring only "gray" or relatively lower quality reclaimed or reused waters currently being met with water of much higher quality.

Conservation, both in the Delta and in other areas dependent on Delta waters, and land retirement and fallowing are used to reduce demand. Combining conservation, land retirement and fallowing, and wastewater reclamation reduces Delta demand by reducing surface water diversions, or in some cases, groundwater pumping.

Key Actions

Levee and Channel Improvements - Actions to improve system reliability, such as channel improvements and levee maintenance and stabilization, modifying agricultural practices to reduce subsidence, providing funding for maintenance and rehabilitation, and maintaining and/or reconstructing levees around infrastructure and habitat are implemented at minimum levels to reduce the risk of the Bay-Delta system, including water supply, water quality, ecosystem quality, and existing land uses/infrastructure, to catastrophic failure.

Levee improvements would focus on levee stability and would include measures such as modifying land use on landside adjacent to levees, creating stabilizing berms, and setback levees. Stabilizing berms would be constructed on the landside or waterside. Waterside berms would only be constructed to enhance aquatic habitat, in a manner that does not destroy existing shoal habitat, and in their presence does not interfere with the conveyance capacities or efficiencies of adjacent channels. An emergency levee management plan would provide the necessary funding and direction to reclaim Delta islands in the event of inundation in order to continue provision of Delta functions as an integrated resource system. Funding would be provided to ensure that a suitable amount of equipment and materials would be readily available to rapidly respond to flood fights.

Actions to control subsidence adjacent to the levees could include modifying agricultural practices adjacent to levees or creating landside habitat. Channel maintenance would improve conveyance of flood flows through the Delta and could include efforts to restore aquatic habitats in combination with waterside berms where current habitat is inadequate.

Conservation - Conservation and water pricing are implemented at higher levels than the current core level to reduce water demand and improve the reliability of the Delta as a source of export water supply. Residential, industrial, and agricultural demand reduction in and upstream of the Delta are implemented to increase Delta inflows in drier water years as needed to meet delivery and environmental obligations. Measures capable of achieving an equivalent, equitable level of demand reduction are implemented in the export areas to improve the reliability of the Delta as a source of export water supply for M&I and agricultural uses.

Reclamation, Discharge Management, and Alternative Supply Development - Reclamation and other cost-effective management of urban and industrial discharges and runoff are implemented at higher than minimum core levels to improve Delta water quality. Incentives for better stormwater management practices, including increased use of detention basins and more effective drainage systems would be provided to reduce event-driven volumes of pollutants entering surface waters or groundwater basins. The development of alternative sources of water supply for export areas will minimally improve the reliability of the Delta as a source of export water supply for current M&I and agricultural needs.

Habitat Restoration - Actions to improve and protect existing [illegible] riparian, and wetland habitats in the Bay-Delta and upstream are implemented at higher-than-minimum core levels. The restoration of riverine, riparian, wetland, and associated terrestrial habitat and expansion of floodway habitat, channels, and meander belts in the Bay-Delta and upstream in rivers and tributaries to restore fish spawning, rearing, and feeding habitats and improve fish survival are implemented at minimum levels, focusing on those having the greatest potential for improvement.

Restoration involving setback levees, channel improvements, and shaded riverine habitat is focused on high priority sites (e.g. to form corridors of key habitat mosaics), and of high feasibility (e.g. along north Delta islands with relatively high interior surface elevations). Habitat restoration involving setback levees and levee reconstruction simultaneously reduces the vulnerability of adjacent land uses to catastrophic failure and protects newly created habitat. Habitat restoration along the landside or waterside of existing levees could be combined with efforts to improve levee stability and mitigate for losses due to levee maintenance and stabilization actions.

Flow Barriers - Install flow barriers in the South Delta in coordination with other flood control, salinity management, and fish transport water management actions. Flow barriers can [illegible] flows, limit flows, or provide one-way tidal flow control.

Supporting Actions

Water Transfers -- Water transfers are implemented at higher levels than minimum to increase water supply reliability. Facilitate additional water marketing during drier water year to increase the efficient utilization of existing water supplies.

Groundwater Banking and Conjunctive Use -- Incentives for conjunctive use are implemented at higher levels than minimum core level to enhance available water supplies. Increase support of efforts to provide increased opportunities for groundwater banking and conjunctive use during drier water years.

Land Retirement and Fallowing -- Implement retirement of marginal agricultural lands and lands from willing sellers at minimal levels. Fallow enough land during drought periods to reduce current M & I deficiencies and agricultural deficiencies while maintaining ecosystem quality at acceptable levels. Land retirement and fallowing of lands adjacent to levees can control subsidence and is potentially available to replace habitat lost

due to levee maintenance and stabilization actions. Land retirement and fallowing in the Delta can also reduce organic content of Delta water used for export purposes or provide islands for conversion to storage.

Develop Export-Area Alternative Supplies -- Develop alternative water supplies such as desalination and potable reuse for export areas to provide current dry year needs. Coordinate these actions with conservation and reclamation actions to ensure that long-term water management flexibility gains are not lost to concurrent increase in future demands.

Modify Reservoir Operations -- Utilize reduced reliance on Delta export water needs to reduce carryover storage and increase flood control space.

Preliminary Assessment

Ecosystem Quality -- This alternative would improve ecosystem quality through habitat restoration and instream flow management above [illegible] and offer increased protection to catastrophic failure to existing habitat. The selection of high priority and highly feasible sites may result in disjointed habitat throughout the Bay-Delta system.

Water Supply -- This alternative improves export water supply reliability by reducing reliance on the Delta as a source of water supply for meeting M&I and agricultural needs through demand reductions and development of alternative sources of supply. The quantity of reductions achieved through these measures may not be sufficient to meet future M&I and agricultural needs. Delta water supply reliability of in-Delta and export water supply is also improved through channel improvements and levee maintenance and stabilization actions and in particular from salinity intrusion by protection of the critical western Delta islands.

Water Quality -- Water quality is improved through the key action of reclamation of agricultural, municipal, and industrial wastewater. Other water quality improvements are achieved by supporting and other actions including mine drainage remediation. Reliability of Delta water quality is also improved through channel improvements and levee maintenance and stabilization actions. Water quality concerns for beneficial use of in-Delta and export water supply due to salinity intrusion is addressed by improving flood protection and seismic resistance of levees on the critical western Delta islands such as Sherman, Jersey and Bradford.

System Vulnerability -- Channel improvements and levee maintenance and stabilization actions improve the reliability of the Delta from catastrophic inundation which protects existing and restored shallow water habitat, land uses, infrastructure, water supply and water quality. These efforts reduce the vulnerability of islands with infrastructure and valuable existing habitat. Flood protection improvements of the levees around the critical western islands increases protection of those islands as well as protecting in-Delta and export water supplies from salinity intrusion due to island failure. Continued protection of Delta functions as an integrated resource system is accomplished by an emergency levee

management plan to provide necessary funding and direction to reclaim Delta islands in the event of inundation. These actions could be accomplished through expansion and continuation of existing programs such as the Delta Flood Protection Act of 1988 (SB 34) as well as sufficient funding of these efforts in the future. The minimum levels of protection for Delta islands will require development and funding of an emergency levee management plan to reclaim Delta islands, an emergency water supply plan to meet needs due to outages, and an emergency water quality plan to address intrusion of salinity due to catastrophic failure of Delta islands.

Alternative SV-2 **Moderate Protection Level of Delta Islands and Systems Functions**

The action categories provided in this alternative address three areas of concern. First, the level of flood protection afforded to Delta islands is improved beyond current conditions. Second, habitat restoration actions are provided to appropriately recognize and address the need to balance flood protection actions and expenditures with corresponding habitat improvement actions and expenditures, since the achievement of flood protection benefits may result in the removal or degradation of aquatic and terrestrial habitat. Third, other actions have been added to provide a measure of equitability with respect to providing water quality benefits, fisheries improvements, and water demand reduction/supply enhancements so that this alternative's implementation addresses as many stakeholders as reasonably possible while preserving the land use/flood control/habitat theme of maintaining the physical configuration of the Delta to continue the beneficial functions provided.

Formulation of this alternative began with the combined preliminary alternatives WS-1, Demand Reduction and WQ-128 Managing Discharges, Restoring Existing and Creating New Habitat in SV-1, Minimum Protection Level of Delta Islands and System Functions. These alternatives represented a sound basis for providing moderate levels of protection to Delta functions and system integrity that would enhance, and in some cases increase levels of protection provided in Alternative SV-1 while preserving habitat restoration improvements achieved in Alternative SV-1. The preliminary assessment of these combined alternatives suggests the following weaknesses with respect to other user groups or beneficial uses:

1. No new sources of water south of the Delta are guaranteed other than generally worded actions to reduce demand.

2. No new sources of water within the Delta are guaranteed to manage Delta outflow.

3. Habitat restoration relies on techniques which collectively could produce large quantities of restored habitat but are unlikely to produce large amounts of restored habitat that will be concentrated in one place.

4. Actions to protect existing aquatic habitat or the creation of new habitat are not the same as actions that directly protect fish. Alternative SV-1 does not contain actions that directly protect fish.

Preliminary alternative WS-11 (Isolated Delta Conveyance and Storage Facility with Export Area Storage) addresses the first two weaknesses and the fourth weakness as follows:

1. Additional off-stream storage on the west side of the San Joaquin Valley is possible by constructing new off-stream storage facilities or a facility adjacent to the California Aqueduct such as the proposed Los Banos Reservoir.

2. A conveyance and storage facility within the Delta is proposed by linking islands

that are flooded for storage with siphons, existing channels, or new channels.

3. Export diversion facilities along the Sacramento River would be relocated as required to reduce diversion impacts on fish populations.

Preliminary alternative WS-7 (Manage Delta Outflow with Delta Storage) addresses the second, third, and fourth weakness as follows:

1. Certain islands could be converted to storage reservoirs to capture water during high flow periods to provide water supply for Delta outflow management.

2. Converting some islands to tidal action in the western Delta and some non-tidal wetlands to tidal wetlands could generate large quantities of estuarine habitat instead of smaller quantities.

3. Real time monitoring practices will act to protect fish.

Diversion modifications are included as key and/or supporting actions of alternatives WS-7 and WS-11. The merging of the various alternatives appears to suggest this can be addressed by listing these as a supporting action in the new alternative SV-2.

The combined preliminary alternatives WS-1 and WQ-128 (SV-1) with WS-11 and WS-7 and including increased levels of levee protection for protection of habitat, infrastructure, and water quality results in a new alternative (SV-2) being generated which is being presented as the "Moderate Protection Level of Delta Islands and Systems Functions" that is acceptable for the Delta Land Use / Vulnerability workgroup.

Remaining Weaknesses of This Alternative

Ecosystem quality improvements do not include upland habitat improvements. No integrated habitat management strategies, upstream habitat improvements, fish hatchery or harvest operations improvements are included.

Water supply actions do not include on-stream storage expansions or the relocation and/or consolidation of diversions. Institutional actions and the establishment of an export capacity market are implemented only at the core level. Actions to improve through-Delta conveyance capabilities are not included.

Flow barrier installation for water quality improvement is not included in this alternative, and the management of agricultural and urban/industrial drainage is only addressed at a moderate level through supporting actions. Dredging and dredge material management is minimally addressed, since this option attempts to integrate channel capacity improvements with natural flood protection measures and increased habitat extent and contiguity.

Alternative SV-2

Group
Land Use/Flood Control/Habitat

Title
Moderate Protection Level of Delta Islands and Systems Functions

This alternative combines key levee and channel improvements, conservation, reclamation, habitat restoration, additional in-Delta and offstream storage, and flow barriers to achieve moderate reductions in system vulnerability, noticeable improvements in Delta aquatic and terrestrial habitat, and equitable water supply flexibility. Those actions are supported by incentives for more groundwater banking and conjunctive use of surface and groundwater, land retirement and fallowing, and alternative supply development, over all regions dependent on Delta waters to ensure that related burdens associated with conservation, reclamation, and other actions leading to higher water costs than now incurred are unilaterally shared. Other supporting actions include modification and/or improvement of conditions at diversions, and modified reservoir operations

The vulnerability of Delta functions (including land use\infrastructure, Delta water quality and supply, export water quality and supply, Delta ecosystem functions) to catastrophic failure is reduced by providing an increased level of flood protection for all Delta islands. The alternative integrates the linkage between flood control and beneficial uses of Delta water supplies through increased flood control actions. This alternative also advances opportunities for protection and large-scale enhancement of habitat elements that have been modified and are currently inadequate as well as constructing facilities within and outside of the Delta that will provide increased reliability of the Delta as a source of export water supply.

Improving levee maintenance and stabilization for all Delta levees (such as Project and Non-Project) in the Delta to a level of flood protection equivalent to the hazard mitigation plan (HMP) standard will reduce the vulnerability of Delta functions to catastrophic failure.

Efforts to reduce the vulnerability around the critical western islands (such as Sherman and Jersey islands) with infrastructure (i.e. the Mokelumne Aqueduct, Transmission Lines, Highway 160, etc.) would include actions to provide a level of flood protection equivalent to the Corps of Engineers Public Law (PL)-99 standard. Efforts to reduce the vulnerability of all Delta islands with infrastructure (such as New Hope Tract, Bouldin Island, Sherman Island, Palm Tract, Lower and Upper Jones Tracts, and Lower Roberts Island) would also include actions to improve flood protection to the level provided by Public Law 99. Islands having valuable habitat, but not necessarily infrastructure would also receive levels of protection equivalent to the Public Law 99 standard, and would include, but not necessarily be limited to Canal Ranch, Brack Tract, Staten Island, Venice Island, Rindge Tract, Webb Tract, Big Mandeville Island, Twitchell Island, and Bradford Island).

Efforts to reduce subsidence on Delta islands with deep peat soils (such as parts of Grand Island, Twitchell Island, Sherman Island, Andrus Island, and Bouldin Island) will include the establishment of a landside buffer zone between 50 and 100 yards in width adjacent to

island levees. Implementation of these actions will moderately improve protection of those islands as well as protecting in-Delta and export water supplies from salinity intrusion due to island failure. In addition, an emergency levee management plan to reclaim Delta islands in the event of inundation is necessary to continue protection of Delta functions as an integrated resource system is recommended.

Land retirement and fallowing in the Delta, accompanied by active management of such retired lands for wildlife (e.g. seasonal wetlands) could provide areas for habitat restoration and could contribute to improved water quality. Land retirement and fallowing in the Sacramento and/or San Joaquin Valleys, or in other marginally productive areas dependent on Delta waters could lead to overall improvements in Delta water quality by reducing the areal extent of agricultural lands (and applied agricultural chemicals) contributing nonpoint and point discharges resulting from irrigation.

Improvements in Delta water quality are also achieved through agricultural, industrial, and municipal wastewater reclamation and reuse (recycled water). The use of recycled water indirectly improves overall system water quality by meeting demands of those users requiring only "gray" or relatively lower quality reclaimed or reused waters currently being met with water of much higher quality.

Conservation, both in the Delta and in other areas dependent on Delta waters, and land retirement and fallowing are used to reduce demand. Combining conservation, land retirement and fallowing, and wastewater reclamation reduces direct demand by reducing surface water diversions, or in some cases, groundwater pumping.

Water supply, habitat, and fish protection issues are further addressed by creation of off-stream and in-Delta storage, by conversion of existing non-tidal wetlands to tidal wetlands and/or inundation of islands to create new wetlands, and diversion and real time monitoring measures to protect fish.

Key Actions

Levee and Channel Improvements - Actions to improve system reliability, such as channel improvements and levee maintenance and stabilization, modifying agricultural practices to reduce subsidence, providing funding for maintenance and stabilization, and maintaining and/or /reconstructing levees around infrastructure are implemented at moderate levels to reduce the risk of the Bay-Delta system, including water supply, water quality, ecosystem quality, and existing land uses/infrastructure.

Levee improvements would focus on levee stability and would include measures such as modifying land use on landsides adjacent to levees, creating stabilizing berms, and setback levees. Stabilizing berms would be constructed on the landside or waterside. Waterside berms would only be constructed to enhance aquatic habitat, in a manner that does not destroy existing shoal habitat, and if their presence does not interfere with the conveyance capacities or efficiency of adjacent channels.

Actions to control subsidence adjacent to the levees could include modifying agricultural practices adjacent to levees or creating landside habitat. Channel maintenance would improve conveyance of flood flows through the Delta and could include efforts to restore aquatic habitats in combination with waterside berms where current habitat is inadequate. An emergency levee management plan would provide necessary funding and direction to reclaim Delta islands in the event of inundation in order to continue protection of Delta functions as an integrated resource system. Funding would be provided to ensure that a suitable amount of equipment and materials would be readily available to rapidly respond to flood fights.

Conservation -Conservation and water pricing are implemented at moderate levels to reduce water demand and improve the reliability of the Delta as a source of export water supply. Residential, industrial, and agricultural demand reduction in and upstream of the Delta are implemented at moderate levels to increase Delta inflows in drier water years as needed to meet delivery and environmental obligations. Measures capable of achieving an equivalent, equitable level of demand reduction are implemented in the export areas to improve the reliability of the Delta as a source of export water supply for M&I and agricultural uses.

Construct in-Delta storage - Core actions such as increasing water supply predictability are implemented at higher levels than minimum core levels by converting existing leveed lands to storage reservoirs. This serves to capture water during high flow periods to provide water supply for Delta outflow management, which serves to improve the reliability of the Delta as a source of export water supply for M&I and agricultural uses. Conversion of islands to storage modifies existing land use, but assists in maintaining the existing physical configuration of the Delta.

Develop additional off-stream storage - Core actions such as increasing water supply predictability are also implemented at higher levels than minimum core levels by constructing new off-stream storage along the west side of the San Joaquin Valley. This serves to improve the reliability of Delta as a source of export water supply for M&I and agricultural uses. Sites could be expanded to include a facility adjacent to the California Aqueduct such as the proposed Los Banos Reservoir.

Reclamation, Discharge Management, and Alternative Supply Development - Reclamation and other cost-effective management of urban and industrial discharges and runoff are implemented at moderate levels to improve Delta water quality. Moderate-level incentives for better stormwater management practices, including increased use of detention basins and more effective drainage systems would be provided to reduce event-driven volumes of pollutants entering surface waters or groundwater basins. The development of alternative sources of water supply for export areas will significantly improve the reliability of the Delta as a source of export water supply for current M&I and agricultural needs.

Habitat Restoration - Actions to improve and protect existing aquatic, riparian, and wetland habitats in the Bay-Delta and upstream are implemented at moderate levels. The

restoration of riverine, riparian, wetland, and adjacent terrestrial habitat, and expansion of floodway habitat, channels, and meander belts in the Bay-Delta and upstream in rivers and tributaries to restore fish spawning, rearing, and feeding habitats and improve fish survival are implementated at moderate levels, focusing on sites having medium to high potential for improvement.

Restoration involving setback levees, channel improvements, and shaded riverine habitat is focused on medium to high priority sites (e.g. to form corridors of key habitat mosaics), and of medium to high feasibility (e.g. along Delta islands with relatively high interior surface elevations). Habitat restoration involving setback levees and levee reconstruction simultaneously reduces the vulnerability of adjacent land uses to catastrophic failure and protects newly created island habitat. Habitat restoration along the landside or waterside of existing levees could be combined with efforts to improve levee stability and mitigate for losses due to levee maintenance and stabilization actions.

Additional habitat restoration actions include the possibility of converting portions of existing leveed lands to tidal action in the western Delta and convert existing non-tidal wetlands such as the Suisun Marsh to tidal wetlands to provide large amounts of additional estuarine habitat.

Flow Barriers -Install flow barriers in the South Delta in coordination with other flood control, salinity management, and fish transport water management actions. Flow barriers can eliminate flows, limit flows, or provide one-way tidal flow control.

Supporting Actions

Water Transfers -- Water transfers are implemented at moderate levels to increase water supply predictability. Facilitate additional water marketing during drier water years to increase the efficient utilization of existing water supplies.

Groundwater Banking and Conjunctive Use -- Incentives for conjunctive use are implemented at moderate levels to enhance available water supplies. Groundwater is stored south of the Delta to increase the reliability of drought supplies. Increase support of efforts to provide increased opportunities for groundwater banking and conjunctive use during drier water years.

Land Retirement and Fallowing -- Implement retirement of marginal agricultural lands and lands from willing sellers at moderate levels. Fallow enough land during drought periods to reduce current M & I deficiencies and agricultural deficiencies while maintaining ecosystem quality at acceptable levels. Land retirement and fallowing of lands adjacent to levees can control subsidence and is potentially available to replace habitat lost due to levee maintenance and stabilization actions. Land retirement and fallowing in the Delta can also reduce organic content of Delta water used for export purposes or provide islands for conversion to storage.

Develop Export-Area Alternative Supplies -- Develop alternative water supplies such as desalination and potable reuse for export areas to provide current dry year needs. Coordinate these actions with conservation and reclamation actions to ensure that long-term water management flexibility gains are not lost to concurrent increase in future demands.

Modify reservoir operations -- Utilize reduced reliance on Delta export water needs to reduce carryover storage and increase flood control space.

Modify diversions -- Modify, consolidate, and relocate diversions to reduce impacts on fish along the Sacramento River and in the Delta.

Preliminary Assessment

Ecosystem Quality -- This alternative would improve ecosystem quality through habitat restoration and instream flow management above current values. The selection of high priority and highly feasible sites may result in disjointed habitat throughout the Bay-Delta system although the incorporation of concentrated large amounts of habitat on flooded islands will tend to create large independent tracts of valuable habitat.

Water Supply -- This alternative improves export water supply reliability by improving the reliability of the Delta as a source of water supply for current M&I and agricultural needs through demand reductions, additional storage facilities, and development of alternative sources of supply. The quantity of reductions achieved through these measures should be sufficient to meet some level of future M&I and agricultural needs because of the creation of new water supply systems including off-stream storage and in-Delta storage. Delta water supply reliability on in-Delta and export water supply is also improved through channel improvements and levee maintenance and stabilization actions and in particular from salinity intrusion by protection of the critical western Delta islands.

Water Quality -- Water quality is improved through the key action of reclamation of agricultural, municipal, and industrial wastewater. Other water quality improvements are achieved by supporting and core actions including mine drainage remediation. Reliability of Delta water quality is also improved through channel improvements and levee maintenance and stabilization actions at moderate levels. Water quality concerns for beneficial use of in-Delta and export water supply due to salinity intrusion is addressed by improving flood protection and seismic resistance of levees on the critical western Delta islands such as Sherman, Jersey and Bradford.

System Vulnerability -- Channel improvements and levee maintenance and stabilization actions at moderate levels further improve the reliability of the Delta from catastrophic inundation which protects existing and restored shallow water habitat, land uses, infrastructure, water supply and water quality. These efforts reduce the vulnerability of islands with infrastructure such as Bacon and the vulnerability of islands with valuable existing habitat such as Bradford. Flood protection improvements of the levees around the

critical western islands such as Sherman and Jersey and/or islands with critical infrastructure (i.e. the Mokelumne Aqueduct, Transmission Lines, Highway 160, etc.) such as Roberts Island increases protection of those islands as well as protecting in-Delta and export water supplies from salinity intrusion and associated beneficial uses due to island failure. Continued protection of Delta functions as an integrated resource system is accomplished by an emergency levee management plan to provide necessary funding and direction to reclaim Delta islands in the event of inundation. These actions could be accomplished through expansion and continuation of existing programs such as the Delta Flood Protection Act of 1988 (SB 34) as well as sufficient funding of these efforts in the future. The minimum levels of protection for Delta islands will require development and funding of an emergency levee management plan to reclaim Delta islands, an emergency water supply plan to meet needs due to outages, and an emergency water quality plan to address intrusion of salinity due to catastrophic failure of Delta islands.

Alternative SV-3 **Maximum Protection Level of Delta Islands and System Functions**

The action categories provided in this alternative address three areas of concern. First, the level of flood protection afforded to Delta islands is improved substantially beyond current conditions. Second, habitat restoration actions are provided at a maximum level to appropriately recognize and address the need to balance flood protection actions and expenditures with corresponding habitat improvement actions and expenditures, since the achievement of flood protection benefits may result in the removal or degradation of aquatic and terrestrial habitat. Third, other actions have been added to provide a high level of equitability with respect to providing water quality benefits, fisheries improvements, and water demand reduction/supply enhancements so that this alternative's implementation addresses as many stakeholders as reasonably possible while preserving the land use/flood control/habitat theme of maintaining the physical configuration of the Delta to continue the beneficial functions provided.

Formulation of this alternative began with preliminary alternative - EQ-348 Improved Operations, Conveyance, and Storage. It was selected as the basis for this maximum levee protection alternative because it provides several key and supporting actions that allow the integration of increased operational flexibility, channel capacities (for flood flow routing), and habitat restoration that will be needed to successfully achieve simultaneous flood protection and Delta habitat restoration improvements. The preliminary assessment of EQ-348 suggests the following:

1. Increased operational flexibility and expanded offstream storage capacity provide improved fishery flow regimes, but only minimal in-Delta habitat improvements are achieved;

2. Only minimal water quality improvements are achieved; and

3. Slightly greater than minimal levee system reconstruction is proposed, but does not integrate habitat improvements with levee system reconfiguration.

Preliminary alternative WQ-125; Managing Watersheds and Restoring Existing and Creating New Habitat, addresses these points as follows:

4. Delta shallow water habitat, and instream, riparian, wetland, and terrestrial habitat is restored and created;

5. Water quality improvements are achieved through increased watershed management; and

6. Key and supporting levee reconstruction actions actively integrate habitat improvements

and improve natural flood protection through increased river meandering, relocation of levees to create flood ways, and modifying flood ways to support wetland habitats.

EQ-348 achieves some water supply benefits by recommending the construction of a small east-side isolated transfer facility that would be operated in coordination with modified upstream reservoir releases and improved Delta inflows. When combined with WQ-125, in-Delta levee system functions and overall integrity are improved in the resulting alternative through the integration of substantial levee reconstruction and habitat restoration and creation. Water quality benefits are achieved through key watershed management actions, and supporting point and nonpoint source discharge reductions. The combined EQ-348/WQ-125 alternative still presents the following weaknesses:

7. Operational flexibility is limited to existing storage, however, revisions in operations will most likely require augmentation of existing supplies by increasing storage; and

8. Actions incorporated enhance supply timing and in-Delta system functions, but do not address demand reduction.

Adding the key and supporting actions of preliminary alternative WS-2 would address these weaknesses by:

Developing storage in the Delta and export areas to facilitate water transfers, capture unregulated flows, minimize storage constraints on exports, and provide critical-period supply.

Implementing maximum achievable residential, industrial, and agricultural demand reduction in and upstream of Delta and in export areas through conservation, reclamation, water marketing, and encouraging groundwater banking and conjunctive use.

Remaining Weaknesses of This Alternative

Ecosystem quality improvements do not include actions to reduce the impacts of diversions (e.g. fish screening) on anadromous and resident fishes, and only minimal upland habitat improvements are recommended. No integrated habitat management strategies, upstream habitat improvements, fish hatchery or harvest operations improvements are included.

Water supply actions do not include on-stream storage expansions or the relocation and/or consolidation of diversions. Institutional actions and the establishment of an export capacity market are implemented only at the core level.

Flow barrier installation for water quality improvement is not included in this alternative, and the management of agricultural and urban/industrial drainage is only addressed at a moderate level

through supporting actions. Dredging and dredge material management is minimally addressed, since this option attempts to integrate channel capacity improvements with natural flood protection measures and increased habitat extent and contiguity.

Alternative SV3

Group	*Title*
Land Use/Flood Protection/Habitat	**Maximum Protection Level of Delta Islands and Systems Functions**

This alternative combines maximum levee improvements with upstream operational modifications, habitat restoration and creation, and storage and conveyance improvements to achieve maximum reductions in system vulnerability, substantial improvements in Delta aquatic and terrestrial habitat, and equitable water supply flexibility. It is supplemented with institutional demand reduction and water quality improvement measures over all regions dependent on Delta waters to ensure that related burdens associated with conservation, reclamation, and other actions leading to higher water costs than now incurred are unilaterally shared.

Improving levee maintenance and stabilization for Delta levees (such as Project and Non-Project) to improve flood protection for all Delta islands will reduce the vulnerability of Delta functions to catastrophic failure. Efforts to reduce the vulnerability around the critical western islands (such as Sherman and Jersey) and islands with infrastructure (e.g. the Mokelumne Aqueduct, transmission lines, Highway 160, etc.) would include actions to provide a level of protection *equivalent to* withstanding the Maximum Credible Earthquake (MCE). Efforts to reduce the vulnerability of all other Delta islands would receive levels of protection equivalent to the Public Law (PL) 99 standard. Efforts to reduce subsidence on Delta islands with deep peat soils (such as parts of Grand Island, Twitchell Island, Sherman Island, Andrus Island, and Bouldin Island and others) will include the establishment of a landside buffer zone between 100 and 200 yards in width adjacent to island levees.

Implementation of these actions will maximally improve protection of those islands as well as protecting in-Delta and export water supplies from salinity intrusion due to island failure. Actions to control subsidence adjacent to the island levees could include modifying agricultural practices adjacent to levees or creating landside habitat. In addition, an emergency levee management plan to reclaim Delta islands in the event of inundation is necessary to continue protection of Delta functions as an integrated resource system.

Land retirement and fallowing in the Delta, accompanied by active management of such retired lands for wildlife (e.g. seasonal wetlands) could provide areas for habitat restoration and could contribute to improved water quality. Land retirement and fallowing in the Sacramento and/or San Joaquin Valleys, or in other marginally productive areas dependent on Delta waters could lead to overall improvements in Delta water quality by reducing the areal extent of agricultural lands (and applied agricultural chemicals) contributing nonpoint and point discharges resulting from irrigation.

Improvements in Delta water quality are also achieved through agricultural, industrial, and

municipal wastewater reclamation and reuse (recycled water). The use of recycled water indirectly improves overall system water quality by meeting demands of those users requiring only "gray" or relatively lower quality reclaimed or reused waters currently being met with water of much higher quality.

Conservation, both in the Delta and in other areas dependent on Delta waters, and land retirement and fallowing are used to reduce demand. Combining conservation, land retirement and fallowing, and wastewater reclamation reduces direct demand by reducing surface water diversions, or in some cases, groundwater pumping.

Flood protection improvements are integrated with Delta shallow water habitat restoration and the creation of a variety of aquatic, riparian, wetland, and terrestrial habitats, supported by upstream and in-Delta natural flood protection measures that allow river meanders and setback levees where such improvements will not compromise desired reductions in system vulnerability. The expansion of off-stream storage and development of storage in the Delta and in export areas increases operational flexibility and improves the reliability of existing Delta inflows for meeting both in-Delta habitat needs and export supply needs. The construction of a small east-side isolated transfer facility designed to improve higher quality water supply reliability complements east-side channel improvements made for flood routing purposes, and improves interrelated operational flexibility with respect to both water supply and flood flow routing capabilities.

Demand reduction actions, including conservation, incentives encouraging groundwater banking and conjunctive use, and reclamation complement other key flood protection, key levee maintenance improvements, stabilization, and seismic protection actions, habitat, and storage/supply enhancement actions by ensuring that long-term flexibility gains are not lost to concurrent increases in future demand. Water quality is protected by improved watershed management, pollution control, and load limits as appropriate. The improved coordination of land use planning and water supply/drought contingency planning at the local and regional levels, increased opportunities for, and reduced regulatory obstacles to water marketing, and land retirement and other core actions reinforce key actions and provide the institutional and legal foundation needed to ensure long-term gains are maintained.

Key Actions

Improve levee maintenance, stabilization, flooding and seismic protections— Improve levees to higher design and seismic standards to withstand the MCE in order to protect water quality for all Delta users, and with respect to conditions near critical western Delta islands, and around other islands with economically valuable infrastructure.

Actions to improve system reliability, including channel improvements and levee maintenance and stabilization, modifying agricultural practices to reduce subsidence, providing funding for maintenance and stabilization, and maintaining and/or reconstructing levees around infrastructure are implemented at maximum levels to substantially reduce the risk of the Bay-Delta system, including water supply, water quality, ecosystem quality, and existing land uses/infrastructure. Channel maintenance would improve conveyance of flood flows through the Delta and could include efforts to restore aquatic habitats in combination with waterside berms where current habitat is inadequate.

Levee improvements would focus on levee stability and would include measures such as modifying land use on landsides adjacent to levees, creating stabilizing berms, and setback levees. Stabilizing berms would be constructed on the landside or waterside. Waterside berms would only be constructed to enhance aquatic habitat, in a manner that does not destroy existing shoal habitat, and if their presence does not interfere with the conveyance capacities or efficiency of adjacent channels. Actions to control subsidence adjacent to the levees could include modifying agricultural practices adjacent to levees or creating landside habitat. Provide buffer strips of a minimum width of 100 yards to minimize subsidence through the restriction of farming in areas with deep peat soils or otherwise susceptible to subsidence. Buffer strip areas could be used in combination with other actions to improve habitat.

Channel maintenance would improve conveyance of flood flows through the Delta and could include efforts to restore aquatic habitats in combination with waterside berms where current habitat is inadequate. Improve flood protection and seismic resistance of levees around the critical western Delta islands such as Sherman, Jersey, and Bradford to protect the Delta water quality from salinity intrusion and associated beneficial uses from catastrophic failure. An emergency levee management plan would provide necessary funding and direction to reclaim Delta islands in the event of inundation in order to continue protection of Delta functions as an integrated resource system. Funding would be provided to ensure that a suitable amount of equipment and materials would be readily available to rapidly respond to flood fights.

Increase east side channel flood flow capacity—Increase flood flow routing capabilities and flexibility from the Sacramento River to the central Delta by increasing the capacities of existing east-side Delta channels and modifying Delta levees to increase flow cross-sections for more effective movement of water. Efforts would focus on the Mokelumne River capacity, but also would include the Consumnes River, Dry Creek, Morrison Creek stream group, and Deer Creek. Capacity increases and natural flood protection measures would be integrated to reduce the incidence of extensive flooding and levee failures affecting interior Delta islands and leveed tracts without substantially compromising valuable habitat components or contiguity.

Restore Delta shallow water habitat—Create new areas of shallow water habitat in the Delta *to* restore historically degraded shallow habitat and increase the spawning and rearing area available

for resident fish species. Create these areas in conjunction with reconstructing levees, reconstructing riverbanks and shallow areas, restoring and preserving channel islands, and subjecting existing leveed lands to tidal action. Integrate these restoration actions with levee improvements and channel capacity increases to minimize losses of high-value riparian and wetland habitat.

Restore Delta and upstream habitat—Create a variety of habitat types upstream of and in the Delta by protecting, enhancing, and creating new instream, wetland, riparian, and terrestrial habitats. Actions to substantially improve and protect existing aquatic, riparian, and wetland habitats in the Bay-Delta and upstream are implemented at maximum levels at sites of low to high priority. The retoration of riverine, riparian, wetland, and adjacent terrestrial habitat, and expansion of floodway habitat, channels, and meander belts in the Bay-Delta and upstream in rivers and tributaries to restore fish spawning, rearing, and feeding habitats and improve fish survival is implemented on low to high priority sites.

Restoration involving setback levees, channel improvements, and shaded riverine habitat is focused on a wide range of low to high priority sites (e.g. to form large and/or contiguous corridors of key habitat mosaics), and of low to high feasibility . Habitat restoration involving setback levees and levee reconstruction simultaneously reduces the vulnerability of adjacent land uses to catastrophic failure and protects newly created island habitat. Habitat restoration along the landside or waterside of existing levees could be combined with efforts to improve levee stability and mitigate for losses due to levee maintenance and stabilization actions.

Additional habitat restoration actions include the possibility of converting portions of existing leveed lands to tidal action in the western Delta and converting existing non-tidal wetlands, such as the Suisun Marsh to tidal wetlands to provide large amounts of additional estuarine habitat.

Expand off-stream storage— Develop additional off-stream storage to increase the reliability of supplies and augment existing supplies, and to allow more flexibility in reservoir operations to accommodate flow and temperature regimes needed by anadromous and resident fisheries. New or expanded off stream storage, the creation of water storage capacity in locations away from the sources of water, may include constructing new reservoirs or increasing the capacity of existing reservoirs.

Modify reservoir operations— Operate upstream reservoirs for increased instream flows, and reduced temperatures to improve habitat conditions. Improved flow and temperature conditions can increase the spawning success of anadromous species, and provide better conditions for developing eggs and larvae. Improved spawning success and better rearing conditions will directly translate into improved health and numbers of anadromous species using the Delta, which will consequently improve population dynamics among all species using the Delta.

Small Eastside Delta isolated transfer facility— Construct small east-side isolated transfer facility for balanced inflow and conveyance benefits. The construction and improvement of the facility would be done in conjunction with other actions intended to improve the transport of water among eastern Delta channels. New or improved facilities would transfer water more efficiently than the current system, and would provide higher quality water to Delta diverters. The small facility would conserve water otherwise lost to seepage, leakage, and evaporation that can occur in tributary channels. Entrainment losses of fishes would also be slightly reduced with more control over eastside flows. That control would reduce the incidence of attraction flows causing fish entrainment and/or stranding in eastside Delta channels.

Develop storage in the Delta and in export areas — Develop storage in the Delta and in export areas to provide additional flood control storage upstream by transferring carryover storage to the Delta, and to otherwise facilitate water transfers, capture unregulated flows, minimize storage constraints on exports, and provide critical-period supply. Several off stream reservoirs are presently in the planning or construction phase, including the Los Vaqueros Reservoir (a project of the Contra Costa Water District), the Domenigoni Valley Reservoir (a project of the Metropolitan Water District of Southern California), and the proposed Delta Wetlands project within the Delta.

Watershed management— Protect water quality by managing mine drainage and land uses within upstream watersheds. Remediate mine drainage by giving urban areas the legal flexibility to fund high-priority mine cleanups as a means of realizing greater returns on cleanup actions and funding than could presently be realized with equivalent expenditures in urban areas. Actions to control heavy metals carried in drainage from abandoned mines would be implemented at very high levels. Acid mine drainage (AMD) control actions would include blockage of water draining from AMD source areas, with relatively higher priorities placed on areas near public watercourses, and actions to completely remediate source area mines and tailings rocks. Managing mine drainage would reduce heavy metal pollution of the Sacramento and San Joaquin River systems and reduce the frequency of fish kills caused by AMD. Spawning and salmon recruitment conditions would be improved.

Conservation— Conservation and water pricing are implemented at maximum levels to substantially reduce water demand and improve the reliability of the Delta as a source of export water supply. Residential, industrial, and agricultural demand reduction in and upstream of the Delta are implemented to increase Delta inflows in drier water years as needed to meet delivery and environmental obligations. Measures capable of achieving an equivalent, equitable maximum level of demand reduction are implemented in the export areas to improve the reliability of the Delta as a source of export water supply for M&I and agricultural uses. Conversion of islands to storage modifies existing land use, but assists in maintaining the physical configuration of the Delta.

Encourage groundwater banking and conjunctive use. Encourage groundwater banking and conjunctive use in the export all areas dependent on Delta waters. Provide incentives for users to shift reliance from surface water to ground water to reduce competition for surface water supplies. Incentives for conjunctive use are implemented at very high levels to enhance available water supplies. Increase support of efforts to provide increased opportunities for groundwater banking and conjunctive use during dry and below normal years to reduce the need for surface waters.

Reclamation, Discharge Management, and Alternative Supply Development -Reclamation and other cost-effective management of urban and industrial discharges and runoff are implemented at maximum levels to improve Delta water quality. Incentives for maximum reasonable improvement of stormwater management practices, including increased construction and use of detention basins and more comprehensive and effective drainage systems would be provided to minimize event-driven volumes of pollutants entering surface waters or groundwater basins. The development of alternative sources of water supply for export areas will greatly improve the reliability of the Delta as a source of export water supply for current M&I and agricultural needs.

Supporting Actions

Improve natural flood protection—Enhance flood protection and create new habitat by allowing rivers to meander, relocating levees to create flood ways, and modifying flood ways to support wetland habitats. Integrate these natural flood protection actions with levee improvements to protect Delta functions as an integrated resource system.

Delta and upstream habitat restoration—Protect riparian lands using purchases and easements, and convert agricultural lands to wetlands where feasible. Reuse agricultural drainage and wastewater effluent to create new wetlands. Clean up sites containing toxic substances and implement pollutant-load limits in the San Joaquin River. These protections, conversions, reuse, and clean up actions will actively create more habitat area, will improve the quality of existing wetland, riparian, and therefore adjacent aquatic habitat, and result in improved conditions for all wildlife species, including candidate and listed species. Improved conditions will increase the health of existing populations and will therefore contribute to improved population dynamics and greater long-term stability of the system's biological integrity.

Develop export area alternative supplies—Develop alternative water supplies (e.g., desalination) for export areas to supplement conservation and reclamation actions to ensure that long-term water management flexibility gains are not lost to concurrent increase in future demands.

Improve coordination of land use planning and water supply planning—Provide incentives for local and regional coordination of land use and water supply planning and support long-term institutional efforts to encourage coordination. Institutional measures that increase (and accelerate) the ability of water managers and operators of state and federal facilities to jointly and cooperatively respond to urgent and/or highly beneficial water management requirements would be afforded high priority.

Water marketing and transfers—Modify the California Water Code to ease the implementation and permitting procedures for water transfers, and establish a brokerage for transfers. Increase the efficient utilization of existing water supplies by facilitating water marketing and market-driven pricing. Water transfers are implemented at maximum reasonable levels to substantially increase water supply predictability. Facilitate additional water marketing during dry and average year supplies to increase the efficient utilization of existing water supplies during periods of peak demand on other sources. Streamlined implementation/permitting of water transfers and the maturation of a market-driven pricing system will increase supply reliability and could subsequently stimulate economic activity by strengthening the financial position of development projects that otherwise may be economically marginal given future uncertainties regarding water availability.

Long-term planning for drought contingencies—Improve drought response planning by developing long-term drought contingency plans. Respond to future drought conditions.by increasing water storage capacities at user locations to provide temporary supplies during shortages or facility outages. This increases the reliability of supplies in such situations.

Land retirement and fallowing—Maximize retirement of marginal agricultural lands and lands of willing sellers. Maximize land fallowing during drought periods. Implement retirement of marginal agricultural lands and lands from willing sellers. Fallow enough land during drought periods to reduce current M & I deficiencies and agricultural deficiencies while maintaining ecosystem quality at acceptable levels. Land retirement and fallowing of lands adjacent to levees can control subsidence and is potentially available to replace habitat lost due to levee maintenance and stabilization actions. Land retirement and fallowing in the Delta can also reduce organic content of Delta water used for export purposes.

Delta inflow management—Create a Delta watermaster's office to manage Delta inflows, central channel operations, and outflows and export operations. The watermaster's office would provide a rapid response capability to be used in coordination with core actions calling for improved real-time monitoring and adaptive management.

Preliminary Assessment

Ecosystem Quality -- Substantial ecosystem quality improvements are realized in the Delta. The restoration of important shallow water habitat benefits resident and anadromous fisheries by providing improved spawning and rearing conditions over a greater area. Riparian, wetland, and terrestrial habitat improvements are integrated with system vulnerability reductions to provide significant increases in the extent, diversity, and long-term stability of these habitats and related values. Improved natural flood protection measures allowing meanders and flood way modification are successfully integrated with levee improvements and construction to provide the diversity in nearshore flow velocities needed to increase fish resting, feeding, and rearing conditions.

Ecosystem quality improvements do not include actions to reduce the impacts of diversions on anadromous and resident fishes. Only minimal upland habitat improvements are recommended, and no integrated habitat management strategies result from implementation of this alternative. In-Delta habitat improvements are emphasized, and upstream habitat improvements minimized. No fish hatchery or harvest operations improvements are included, nor are major improvements in fish screening beyond ongoing projects.

Water Supply -- Increased storage, through expanded capacity at existing off-stream facilities and new in-Delta and export-area storage augments existing supplies. Operational flexibility is therefore enhanced, resulting in reduced competition for water during critical biological and

supply periods. The construction of a small east-side conveyance facility supports these operational flexibility increases, and provides a means of more effectively supplying export water without compromising habitat gains achieved in the Delta.

Water supply actions do not include on-stream storage expansions or new construction, or the relocation and/or consolidation of diversions. Institutional actions and the establishment of an export capacity market are implemented at the core level.

Water Quality -- Water quality improvements are achieved directly by improved drainage management, remediating sources of pollution, and imposing pollutant load limits, and indirectly through reclamation and reuse, conservation, and other measures that reduce demands on relatively higher quality surface waters. Water quality improvements are also achieved through system vulnerability reductions discussed below.

Flow barrier installation for water quality improvement is not included in this alternative, and the management of agricultural drainage is only addressed at a moderate level through supporting actions. Similarly, the management of urban/industrial drainage and wastewater discharge is only minimally addressed.

System Vulnerability -- System vulnerability is achieved to the maximum extent. Western Delta islands having critical importance for protecting water quality (e.g. in minimizing saltwater intrusion or organic degradation resulting from catastrophic failure) are provided levees capable of withstanding the MCE. A similar level of protection is provided to those islands deemed to have infrastructure of critical economic value. Islands containing deep peat soils and valuable habitat are provided with land-side berms of at least 75 yards in width to minimize subsidence. Dredging and dredge material management is minimally addressed, since this option attempts to integrate channel capacity improvements with natural flood protection measures and increased habitat extent and contiguity.